INTERNATIONAL SCIENCE AND TECHNOLOGY AND FOREIGN POLICY

HEARINGS

BEFORE THE

SUBCOMMITTEE ON INTERNATIONAL SCIENTIFIC COOPERATION

OF THE

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY U.S. HOUSE OF REPRESENTATIVES

ONE HUNDRED FIRST CONGRESS

SECOND SESSION

APRIL 4, 26, 1990

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INTERNATIONAL SCIENCE AND TECHNOLOGY AND FOREIGN POLICY

WEDNESDAY, APRIL 4, 1990

U.S. HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
SUBCOMMITTEE ON INTERNATIONAL SCIENTIFIC COOPERATION,
Washington, D.C.

The subcommittee met, pursuant to notice, at 2:15 pm., in Room 2325, Rayburn House Office Building, Hon. Ralph Hall [chairman of the subcommittee] presiding.

Mr. HALL. The Subcommittee on International Scientific Cooperation will come to order.

I am pleased to convene the first of two hearings on a very important and multi-faceted topic, the connections between science and technology and U.S. foreign policy. Today we will hear testimony from four witnesses and we will have the testimony of a fifth witness representing academia and the private sector. On April 26 we will continue our review with several representatives of the Administration.

Twelve years ago, the Congress enacted Title V of Public Law 95-426, a provision designed to elevate science and technology both within the State Department and as an element of U.S. foreign policy. In 1978, the common view was that U.S. science and technology were so desirable and so pre-eminent that they could be offered around the world as diplomatic bargaining chips.

But during the 1980s, the landscape changed. In 1988, amid growing concerns about the rising trade deficit and lagging industrial competitiveness, the Congress amended Title V. The 1988 amendments speak not of offering U.S. science and technology to the world, but of restricting U.S. science and technology. S&T agreements were to be pursued primarily as tools, either to ensure access to foreign technology or to force concessions in discussions related to intellectual property protection.

As a Nation, we still are not quite certain how to use our S&T capabilities abroad. On one hand, the range of large worthwhile scientific endeavors—space station, SSC, global change, genetic mapping, AIDS research—is such that no one nation can possibly tackle them alone, either financially or intellectually. On the other hand, we remain concerned that if all of these projects are internationalized, the commercial benefits that flow from them will end up in the hands of our economic competitors.

There are other equally timely questions we might ask about our international S&T policy. What sort of S&T linkages should we be

pursuing with Eastern Europe? With the emerging democracies of Latin America? Should we make a commitment to go to the moon or to Mars with the Soviet Union?

Our purpose here today is twofold. First, we will examine S&T opportunities for the U.S. in light of the profound political changes occurring throughout the world, and secondly to review Title V to determine whether changes are needed either in the law itself or in its implementation.

We expect that our distinguished panel of witnesses will be able to give us guidance on all of these issues, and hope that in working together we will ensure that the talent of the American scientific and technological community will be most effectively tapped for the betterment of all mankind.

We have Dr. Ralph E. Gomory, President of the Alfred P. Sloan Foundation in New York as our first witness. Dr. William Nierenberg will not be with us, he is ill, but he has submitted a statement that will, without objection, be placed in the record.

[See Appendix II, p.—.]

Mr. HALL. We also have Dr. James O'Connell, Director of International Trade and Policy Affairs, Control Data Corporation of Washington, D.C., Professor Herman Pollack, Professor of International Affairs, George Washington University, Washington, D.C., and Dr. Alvin W. Trivelpiece, Vice President, Martin Marietta Corporation, Director of the Oak Ridge National Laboratory, Oak Ridge, Tennessee.

We are loaded with talent here today, and good looks, and apparent vigor. We really are grateful to have men of your talent, category and background to come and give your Nation and this Congress and this Subcommittee the benefit of your advice.

We look forward to hearing from you.

[The prepared opening statement of Mr. Hall follows:]

OPENING STATEMENT BY CONGRESSMAN RALPH M. HALL

"INTERNATIONAL SCIENCE AND TECHNOLOGY AND FOREIGN POLICY"

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agreements were to be pursued primarily as tools -- either to ensure access to foreign technology or to force concessions in discussions related to intellectual property protection.

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Mr. HALL. Once again, I will throw the hearing open for opening statements from anyone.

Congressman Fawell?

Mr. FAWELL. I just came from the Labor Committee, and I do not have a prepared opening statement, but I want to welcome our witnesses.

Mr. HALL. Thank you.

At this time, we will recognize Dr. Gomory. Your first statement might be that I have mispronounced your name.

Mr. GOMORY. No, you are one of the very small number of persons who has pronounced it correctly.

Mr. HALL. Well, it is not a tough name, and I have been practicing on it for the last 15 minutes.

Mr. GOMORY. However, I might point out for the record that my middle initial is "E", not "A."

Mr. HALL. All right. The record is corrected. Would you care to tell us what the "E" stands for?

Mr. GOMORY. Edward.

Mr. HALL. That is a staunch, fine name. We recognize you, sir.

STATEMENT OF RALPH E. GOMORY, PRESIDENT, ALFRED P. SLOAN FOUNDATION, NEW YORK, NEW YORK

Mr. GOMORY. I certainly feel privileged to be here today and have the opportunity to talk with this Subcommittee.

My own experience in these matters has not been as a person who either arranged them or participated in these exchanges, but as a person who spent some 30 years in industry dealing with large organizations whose people individually exchange information as part of the scientific community. The organizations also have a tremendous internal flow of information.

For example, an international company has a major flow of information between its laboratory in Switzerland and its laboratory in the United States, and so on.

My opinion, based on this particular industrial perspective, is very much in consonant with what Mr. Hall said, I think it is time to rethink the subject of international exchanges in view of the many major changes that have taken place in the world. I would like to summarize what I think are at least three of the things that ought to be rethought. Then I would like to enlarge briefly on those three things.

First, the opening up of nations that were formerly closed—closed in the sense that they regulated the flow of their scientific and technical people—is likely, for example in Eastern Europe, in the near future to open up the more typical exchanges we are accustomed to with free countries. To a considerable extent, this will make less important the government-orchestrated exchanges that we have been used to.

As I will try to explain, these things are much smaller in scale than what happens in the more free world.

It is a fact which we all appreciate that the U.S. scientific and technological leadership has been greatly diminished, and in some areas disappeared. On the other hand, our habits of mind and also the things that are funded were really funded in a world where we

were the leaders and everyone wanted to visit us. We did not have a great deal of motivation to visit others. Because of that, we have to rethink the Government or otherwise sponsored flows to make sure that our people visit centers of excellence abroad.

The third element I think has changed more recently is the decrease in what we have considered, the prime national rivalry—the U.S.-Soviet one. I think any of these decreases in national rivalries give us the opportunity to pursue the really large projects, the great and extensive pieces of science, in a much better way.

I think when we say that, people tend to think primarily of cost-sharing. Perhaps more important even than that is that it gives us the opportunity to pursue these things at an appropriate pace. We can decide how fast we want to proceed in nuclear physics or in space, on the basis of how much it does for us scientifically, technologically, or for the world, in whatever dimension you want to measure it, rather than as part of a race.

I would like to say a few more words about those three points. First, the contrast of the organized and governmental exchanges such as we have had in the past with the Soviet Union was what I see as the more normal levels and means of interchange. First of all, they are on a different scale. When you have a government-arranged interchanged, there are 20 to 50, and occasionally 100 people, or a total of 200 people. That's the scale on which these things take place.

However, in my own experience and that of anyone else who is a participant in the scientific and industrial world, meetings of 30,000 people, occasionally 50,000 people, take place all the time. If you go to a meeting in Las Vegas, the reason it is in Las Vegas is that Las Vegas is one of the few places that can stand to have a meeting of 30,000 people, of whom 3,000 will be from abroad. At that one meeting, far more information is exchanged than in many years of government-arranged interchanges. But the people who are there, of course, are not from Russia. In the future, they may well be.

In addition to these very, very obvious things that take place, there are within the international corporations enormous flows of information. Without belaboring the detail, the point I want to make is that when you are dealing with the normal countries of the world, who are in any reasonably well- developed state, the things that happen through the scientific societies, the engineering societies, the normal activities of companies on another scale are far beyond what you think of with a government-arranged exchange.

Secondly, this business of the two-way flow—in other words, most of our institutions did evolve, and we have fellowships of foreigners here, most foreigners are used to the thought of going to the United States. On the other hand, very few Americans think that they should, as part of their career, go to the Max Planck Institute in Germany or other places—Japan, for instance—as a part of their career. First of all, it is not well-funded to do that, secondly, the world in which we live does not tend to reward that in any particular way. With American two-career families, it becomes increasingly difficult to do that.

We don't have a tradition of going abroad to centers of excellence. I think we should think that now we are not alone in the world of science and technology, that we need to do that. We need to push it, because it will not occur naturally. Whereas the flow in the opposite direction does, after some 20 years of practice, occur naturally.

By the way, one dimension of international exchange which I should have mentioned in my first point, which again is not two-way, is the enormous number of foreign scientific and technical students in the United States. Today there are on the order of 150,000 of these people. Again, when we compare that with the orchestrated exchanges we see that the free world is linked to them by their coming to us on an enormous scale. We will, I think, unless something intervenes, be linked to the newly-liberated countries in that way.

Two points—you can't match this with a government-orchestrated exchange. And it is too one-way. We need to learn from the others.

My final point is that I think all of us who have lived through the post-war world from the beginning of it are aware that many of the enormous scientific projects we have had—notably space, some of the great nuclear-oriented programs—have been animated not only by their scientific importance, but also by the element of national rivalry.

I think it would be a great thing if we were able to proportion our efforts in these directions more precisely to the benefits that go with them. There are several things that have in the past fought against that. One is nationalism. Second is the notion which I think the Chairman also mentioned in his opening remarks, that we would lose the benefits and suffer in some way as a nation from a shared SSC or things of that sort.

I think a more sophisticated view of this which differentiates more clearly between very advanced science and the business of technology and making products says that it is not likely. When we spend huge sums to advance science, science tends to be a world-wide enterprise. The time required for scientific knowledge to filter through the many stages that lie between that and product is so long that by the time this occurs, science has also diffused around the world. The notion of appropriating science to a country is a very difficult one in practice. Certainly our experience with the Japanese has shown that we have been a leading scientific country, but that they have been as able to benefit from it as we have.

The second objection to international sharing, which is that we would lose a significant advantage which would translate into industry—I think that is wrong. There is a growing realization of that distinction.

Thirdly, with the world being more and more affected by the actions of individual countries of which the environmental issues are an example, there is a third category of international efforts which would benefit from being done internationally. Many of these other things are harder to do internationally. It is harder to do an international supercollider, it is harder to have an international space program. But by God, it is probably easier to have studies of the world-wide environment on an international basis. So there is a

third reason, which is that there are these things that are better done internationally.

In a changing world, the nationalism, the fear of losing a scientific advantage, the increasing international aspect of many of our great enterprises all point to doing these things much more on an international basis.

Thank you very much.

[The prepared statement of Dr. Gomory follows:]

TESTIMONY OF MR. RALPH E. GOMORY, ALFRED P. SLOAN FOUNDATION

I certainly feel privileged to be here today and to have the opportunity of testifying to the members of this committee.

My own experience has been less in direct participation in government organized exchanges, and much more as a participant in the scientific and technological scene itself. During the almost 20 years during which I was responsible for research in IBM I had the opportunity to see how information was actually exchanged among scientists from many different disciples, physicists, chemists, electrical engineers etc. Among technologists and engineers in product development labs, and among the various parts of a large multinational company. Even the research labs for which I was responsible spanned the U.S., Switzerland and Japan. It is against this background of private sector exchange that I tend to view the government role in technological exchanges.

My opinion, based on this particular background is that it is time to rethink the whole subject of international exchange of scientific and technological information in view of the immense changes that have taken place in the world in the last few years. Let me say what I want to say in a few sentences and then enlarge on the basic points.

First, the opening up of formerly closed nations, is likely, in the near future, make less important the government orchestrated exchanges that we have been used to and supplant them with much freer and larger spontaneous exchanges.

Second, the greatly diminished U.S. scientific and technical dominance makes it wise for us to be visitors to centers of excellence abroad, not always the one who is visited. Yet our institutions are almost exclusively geared to the latter.

Third, the decrease in U.S. - Soviet tensions gives us the opportunity to pursue the great and expensive pieces of large scale science in a better way. I am referring not only to the possibility of international cost sharing on these huge and costly enterprises, such as space exploration, but probably more importantly to the ability to pursue them at a pace that is proportioned to their cost on the one hand and their scientific or other worth on the other, rather than being driven by national rivalries.

I would like to enlarge briefly on these three points.

There are signifigant differences in technological exchanges between free nations of some degree of development and technical exchanges with a country like the Soviet Union which until almost the present rigidly controlled the entry and exit of its scientists. The latter case, exchanges with the Soviets for example, lends itself to government control and exchanges, especially bilateral ones can be used for their actual value as information exchange and both for their actual and their symbolic value in international negotiations. These government exchanges are usually small, perhaps 200 in a year, and usually scientists rather than engineers, but, small as they are, they represent a large fraction of all the people who do get to talk to each other across these rigidly controlled national boundaries.

On the other hand in the free and developed nations exchanges take place in almost every imaginable way and on a totally different scale. When the electrical and electronic engineering societies have a large international meeting, tens of thousands attend, thousands from foreign countries. When we talk about foreign visits or visitors to this country on a longer term basis we should realize that there are today 150,000 foreign scientific and engineering students in our country, taking part in the scientific and engineering life of this country at various levels. This type of interchange of information is on a totally different scale. It is thorough, exhaustive, unregulated and virtually unregulatable. It is a totally different regime from the small groups of visiting Soviets or the little clusters of blue coated Chinese that characterized the recent past. I discuss this contrast in order to show why I think that with the opening up of the formerly Communist countries and hopefully of the Soviet Union itself, we will be getting into a regime in which the old and limited exchanges will lose much of their meaning.

Secondly. There are today leading scientific institutions in both Europe and Japan whose equipment and general excellence equal or occasionally lead their U.S. counterparts. These can be both scientific and technological institutions. The latter are especially prominent in Japan. Yet the number of Americans making extensive visits to these places, or spending a year there, becoming part of these communities is very small. We are not geared up to do this financially, or for that matter psychologically. In some cases such absences from the home turf are not regarded as good for one's career, whether that career be academic or business. We need to change both the practical and psychological aspects of this situation or we will be disadvantaged relative to countries that do a better job of learning from us than we do in learning from them.

Thirdly. We and other countries spend huge sums, many billions, on programs such as Superconducting Supercollider, space exploration etc. The motivations behind these multibillion dollar efforts are mixed. Certainly no one who was alive during the Sputnik period or who remembers the dramatic announcement of our intent to put a man on the moon can doubt the element of national rivalry that was a major contributor to the space program. Similarly there is a definite element of this in other programs, However with the diminishing of the intense U.S. - Soviet rivalry perhaps the time has come to reconsider not so much the goals but the pace of these programs.

Another background element that has changed and may contribute to a less nationalistic approach to these issues is the growing realization that Science is not easily appropriated by the nation doing it. Science is vital, it moves the world forward, but science takes a long time to find its way into the products that are the stuff of international competitiveness. And by the time that has occurred, the knowledge has often diffused around the world. This means that scientific progress is not always directly linked to economic rivalry and that we can sometimes afford to cooperate with little loss of national competitiveness. How true this is depends on the subject matter, it would be easier to collaborate on a supercollider project than on a supercomputer.

Finally there are programs whose benefits are worldwide and whose nature is also worldwide. Studies of worldwide environmental change fall clearly into this category. The increasing need for such studies is one more argument for increasing scientific cooperation.

To summarize then, I think that the changing international scene will over time diminish the importance of the more formal governmental interchanges, make more important the two way flow of information, (into as well as out of the U.S.), and render more possible and more rewarding international scientific cooperation on large projects.

Mr. BROWN [ASSUMING CHAIR]. Thank you very much, Dr. Gomory.

Mr. BROWN. Do you want to go next, Professor Pollack?

STATEMENT OF HERMAN POLLACK, PROFESSOR OF INTERNATIONAL AFFAIRS, GEORGE WASHINGTON UNIVERSITY, WASHINGTON, D.C.

Mr. POLLACK. Thank you. I appreciate the opportunity to appear before this Subcommittee. I find, as I had expected would be the case, if I did not go first, I would be in the process of iterating what the previous speaker had to say.

My comments today will be, to a degree more than I had anticipated, underscoring some of the remarks Dr. Gomory has made.

I want to make clear, so that you can put my comments in perspective, that I am discussing principally governmental relations in science, not academic, nor those of the industrial and business community. Much of what I have to say would not apply to those other areas.

I also want to, as an early remark, say that I have been troubled for years by the joining of science and technology as a glib expression of a broad field. While the continuum is clear and well-known, for purposes of governmental and international policy, the differences are more important. In essence, science is open, and technology is closed. I can elaborate on that, but that is the basic point. One is proprietary, and the other seeks to be the first to get it out in a publication.

When the Government acts on science and technology, not everyone understands that distinction. I don't believe it has ever been possible, nor is it now, to write rules or regulations or establish policies that apply equally well to both. When that happens, the tendency is to overwhelm the scientific relationship by requiring it to operate under conditions more appropriate to technological relationships. All I am making here is a plea to keep that distinction in mind, and to seek your thoughts on disassociating the two terms when writing legislation and when thinking about the subject.

The second point I want to make is that international cooperation in science as carried on by the Government has been and is currently the handmaiden of foreign policy. There are supposed to be some 600 agreements now in place, the great bulk of them agency agreements. I don't know of any of them—possibly there are exceptions—where this agreement was motivated by the scientist or the technical people saying they had a technical argument as to why they need this cooperation.

In every instance the motivation lay in foreign policy, and more lately sometimes in budgetary considerations. If in making that statement, if I exaggerate, I insist the exaggeration is modest.

Thirdly, we have been in the business, as a Government, of agreements for scientific cooperation for a relatively short period. They began, as far as I can establish, in 1961 with the Kennedy-Ikeda Agreement for scientific cooperation with Japan. It is good to keep in mind that when we began this activity as a government, the United States was in every way the world's leader, not only in

science, but in economics, industry and military capability, nuclear energy, space, you name it.

It has become evident, of course, in the past decade, that the United States' leadership is no longer to be taken for granted, and we are no longer first in every important field. As this change emerged in the policy consciousness, there also emerged concern that cooperation might unwittingly be doing harm to the U.S. economic competitive position, or to U.S. security interests.

Whereas in the 1960s and perhaps the early 1970s it was common, or at least frequent, for U.S. leadership to be speaking up on behalf of the value of international cooperation in science and in other fields, that is no longer a prominent topic of conversation on the part of our leadership. When cooperation in science is taken up today, it is immediately followed by several clauses which call attention to economic competitiveness, and national security. They always go without saying together.

We do not hear much about how the U.S. national interest is advanced by international cooperation in science. While I am extremely sensitive to the need to protect U.S. security and protect our economic position, I do think we must be careful not to permit those legitimate concerns to black out the positive results and benefits of cooperation. Cooperation is not the enemy of competition, and national security does not depend upon the absence of cooperation.

During these same 30 years the United States has been in the business of cooperating with other governments in science and "technology" the world has been moving along at an ever faster pace toward interdependence and an economy that operates and makes sense only in global terms. These have been the years that have brought into prominence the multinational corporation and the increasing frequency of business decisions based on economic factors rather than national considerations.

These have been the years that have seen the rise of the world car, and the world airplane, and the concept in general of international trade being predicated on international division of production. We have arrived at a point where business and industry are engaged in massive international cooperation on a pragmatic basis. The academic community of course, aside from the Government, has been engaged in massive cooperation for generations. The dimensions of cooperation engaged in by the Government simply pales in comparison.

I don't know enough about military coproduction to make a positive statement, but that may well be an exception. That is very large scale, and that fits my definition of cooperation. While this is a terrible time to predict the future, given the events of the past several years—actually it is a more terrible time to predict the future than at any time in the last generation—nevertheless, policy planning requires that some assumptions be made.

I would suggest that the trend toward internationalization of industry and business will intensify. I would also suggest that our political posture and policies will not keep pace with the changing times in the future, as they have not done so until now.

In the next decade the United States will no longer be the dominant force in industry, economics, scientific or technological

achievements—at least not to the degree it has been in the past. That being the case, it might be wise to adopt an approach toward other countries that is predicated on an equality and mutuality of interest and benefits that has not often been evidenced in the past.

We should become considerably more proactive than has been the case in the past. Most of the governmental agreements I am familiar with were occasioned by the need for a Chief Executive meeting between the United States and another country to have something for that final communiques, since the substance of the meeting could not be agreed upon. We did want to leave word behind that we still retained affection for the other country, and we were looking for something positive to say.

I remember President Johnson saying he would send a science advisor over to Pakistan to take a look at the water problems. That was an agreement. Most of them follow that same path.

Also in the past, it has been implicit if not explicit that the other side was receiving all the benefits, and that the returns were in their favor. I am going to shield myself in authority and end up with two brief quotes.

Bob White, the President of the NAE, said recently on the occasion of the National Academy of Engineering's 25th Anniversary celebration, "Just as environmental deterioration cannot be addressed within a single nation, so the economic growth of nations is no longer sustainable within their political boundaries. Just as environmental sovereignty is a thing of the past, so is economic sovereignty."

George Schultz, former Secretary of State, and Professor at Stanford, opened a statement by saying "The world is shifting gears. Enormous changes are now underway, affecting everything from science to superpower relations. In any time of profound change, one of the hardest adjustments to make is intellectual adjustment. We must discard outdated habits of thinking, and make room for new possibilities."

Later he used a phrase I thought was well put—he was speaking of the lag between political concept and technological reality. The last time I heard a phrase used like that, it was Dean Rusk, and that goes back many years, indicating once more that there is very little new under the sun.

Thank you, Mr. Chairman.

[The prepared statement of Professor Pollack follows:]

Testimony by Herman Pollack

Wednesday, April 4, 1990
Subcommittee on International Scientific Cooperation
House Committee on Science, Space and Technology

Mr. Chairman:

My remarks today will address a few of the observations in the papers I submitted to the Subcommittee for these hearings and to the questions listed in the invitation to appear today.

1. First the term "science and technology": Although the continuum is clear and well known, for purposes of international policy the differences are more important. In essence, science prospers through wide dissemination of its findings in publications, meetings and by voice, exchanges of visits in scientific laboratories and institutions, and similar expressions of openness. Technology, on the other hand, is typically proprietary, closely guarded, protected by patents and otherwise treated as a property.

In governmental decision making these distinctions are not always acknowledged. I don't believe it is possible to write rules that apply equally well to both. When you do there is a tendency, particularly but not limited to the past decade, to require scientific relationships to operate under restrictions and conditions appropriate to technological relationships. It would be helpful to disassociate the two terms for purposes of policy making and to treat each on its own merits.

2. International cooperation in science insofar as the government is concerned, has been and is the handmaiden of foreign policy. I do not know of any governmental agreement for cooperation which was motivated by technical considerations. In every instance the motivation was foreign policy or, lately, budgetary considerations. If there is any exaggeration in that statement, the exaggeration is modest. Although the initial motivation may not be scientific necessity, nevertheless very often the progress of science is fostered by these agreements.

1. The U.S. Government has made use of bilateral agreements for scientific cooperation for 30 years. In the early years the United States was the world's leader in every important way, including science. The United States was the world's leading proponent of cooperation - in basic science, nuclear energy, space and other fields. It became evident in the past decade that U.S. leadership was being challenged and we were no longer first in every important field.

As this change emerged so did the concern that by cooperation the United States might unwittingly be doing harm to its international economic competitive position. This concern was accompanied by another relating to possible damage to U.S. security interests as a result of information and technology transferred in the course of cooperative activities.

At this point in time, the United States is not speaking up at responsible levels about the values and desirability of international cooperation in science. When it does, the context now is in terms of the protection of U.S. security and competitive economic position. How the U.S. national interest is advanced by international cooperation in science does not figure largely in the statements of our leadership. I am extremely sensitive to the need to protect U.S. security and protect our economic position, but we must be careful not to permit those legitimate concerns to black out the positive returns and benefits of cooperation.

4. During these same 30 years the world has been moving with increasing speed towards interdependence and an economy that operates and makes sense only on global terms. These years have witnessed the rise into prominence of the multinational corporation and the increasing frequency of business decisions based on economic factors rather than national considerations. It is in this era that we have seen the rise of the "world" car, the "world" airplane and the concept in general of international trade being predicated on international division of production. In short, we have arrived at a point where business and industry is engaged in international cooperation on a pragmatic basis on a very large scale. The dimensions of cooperation engaged in by governments pales in comparison. (Military co-production is a possible exception).

5. Although it is more than foolhardy to predict the future, policy planning requires some assumptions as to what the future will bring. It is likely that the trend toward internationalization of industry and business will intensify and even more likely that our political posture and policies will not keep pace with the changing times, nor have they done so till now. If the United States in the next decade will no longer dominate the world in industrial, economic, scientific or technological achievements as it has in the past, then it might be wise to adopt an approach to other countries that is predicated on an equality and a mutuality of interests and benefits that has very seldom been present in the past. The United States should become considerably more proactive than has been the case till now. In the past it has been implicit, if not explicit, that the other signatory was the beneficiary of cooperation agreements and that the returns were in his favor.

I turn now to the questions contained in the Chairman's letter.

1. What specific legislative changes would you recommend for Title V?

There are three (3) changes I would suggest.

First, the fixed requirements for an annual report to the Congress on personnel requirements and training and on various aspects of existing agreements has resulted in pro forma reports of little value to the agencies and to the Congress. At the time of enactment of Title V I suggested, and I now repeat my suggestion, that the intention of the Congress would be better served if the reporting requirement called for a report every year, or possibly two on one of the major problems involved in bilateral and multilateral agreements for cooperation, the topic being selected by the Executive Branch in consultation with the appropriate committees of the Congress.

Second, except possibly as general expression of concern in the section on policy, I would remove the burdens imposed by Title V on agreements for scientific cooperation relating to intellectual property. The weapon is simply unequal to the task. Protection of intellectual property would be better suited to assistance and trade legislation.

Third, I suggest uncluttering the language of Title V which has become excessively procedural with its specifications for interagency clearances and notification.

2. How effectively has the Department of State served as lead agency with respect to international science and technology agreements? Is the interagency process for developing and implementing science and technology policy working well?

The State Department's ability to serve as lead agency has been curtailed considerably by the rise of NSC committees as the forum for developing policy on international science matters. The Department has also had to contend with increasingly aggressive exercise of power by the Departments of Defense, Commerce and Transportation and by the White House Science Advisor - e.g. space, technology transfer, and intellectual property. I am fearful that what frequently takes place is projection of a special interest rather than concern with overall national interest.

3. As a member of the OES Advisory Committee, what have been your recommendations for improving the State Department's role in the international science and technology arena?

During my tenure with the Advisory Committee I do not recall it ever dealing with the Department's "role". My personal views are best found in a paper I submitted to the Committee entitled "Science and Technology Advice to the Secretary of State".

4. How effective, overall, has the U.S. been in using science and technology as a foreign policy tool?

Let me suggest the heretical thought that it is the signature of the agreement rather than its implementation that is the primary foreign policy payoff, as has been the case in the agreements with the Soviet Union, China and other countries. It is the use of the agreement to signal a political attitude that is important from the viewpoint of foreign policy.

In general, there is little evidence that those who make the decisions on U.S. foreign policy give much thought to the use of science and technology as a foreign policy tool, beyond using agreements as signals.

5. Comment on statement that U.S. collaboration is "incoherent, inconsistent, and arbitrary"?

That is a vivid way of describing the current situation. It is a result of decision by committee and the unwillingness or inability of the Executive Branch to resolve conflicting objectives and policies - such as those relating to national security, technology transfer, economic competition and the conduct of cooperative scientific activities.

6. Should all areas of science and technology come under one policy umbrella?

I do not know.

7. Title V and intellectual property rights and equal access.

As to intellectual property rights see my second suggestion under question 1.

As to equal access, I believe the statement of Congressional policy is useful. It reinforces a long standing executive attitude.

8. Attitude to Foreign Service Journal article on Intellectual Property?

I agree with the points made by the article.

9. Overall, is the United States missing opportunities for international cooperation and burden sharing in the areas of science and technology?

I would amend the question by changing the words "opportunity for" to "advantages of". In either case, the answer is clearly yes. In my view, the burden has been placed on the technical agencies with insufficient guidance from the President or Secretary of State. Other things being equal cooperation complicates the pursuit of a technical objective. However, if the country's leadership were to look upon agreements for cooperation as a way of demonstrating U.S. leadership in world affairs and if the national interest were defined as profiting from sharing of knowledge, the technical agencies would give the benefit of the doubt and more to cooperative enterprises.

Mr. BROWN. Thank you, Professor Pollack, for those wise observations.

Mr. BROWN. Mr. O'Connell?

STATEMENT OF JAMES J. O'CONNELL, DIRECTOR, INTERNATIONAL TRADE POLICY, CONTROL DATA CORPORATION

Mr. O'CONNELL. Thank you very much, Mr. Chairman. It is exceedingly difficult to follow George Schultz and Dean Rusk, but I will do my best.

Thank you for the opportunity to share our thoughts on the subject of international technology flows and science and technology agreements. We commend you for focusing on this subject, which has important implications for U.S. competitiveness and international cooperation.

With your permission, Mr. Chairman, I would like to summarize the key points of the statement and then request that it be included in the record in its entirety.

Mr. BROWN. Your request is granted in its entirety. The statement will appear in the record.

Mr. O'CONNELL. Thank you.

The key points of my remarks today are that equity must be built into the negotiation of international trade and science and technology agreements, and that the U.S. Government must act as a facilitator in implementing equitable technology flows and cooperation with our trading partners.

Our objective should be mutually beneficial international science and technology cooperation. I think the concept of cooperation really must be the key in our international science and technology policy. Negotiating to achieve equitable technology flows recognizes a new competitive reality: The U.S. and the world have entered an era of "internationalization" or global diffusion of technology, which was spoken about by the two previous witnesses.

Technology has become a fluid organism. It does not respect national borders. Similarly, the U.S. Government cannot protect our technology leadership or stop its outflow. Governments must not try to build walls to block access to fundamental knowledge. "Technology nationalism" not only does not work, it could prove counterproductive. We should strive, instead, for balance, for a two-way street in technology transfer.

The reality today is that the United States is no longer self-sufficient in technology. Our international comparative advantage in technology, which has been the key to our global competitiveness in many industries, is now shared with competitors. After decades of transferring up to six times more than we acquired, America's technology competitiveness increasingly will be influenced by our ability to acquire technology from abroad.

In preparation for this hearing, I went back to an old publication, a book written by Edward Denison in the 1970s which is a classic in the field of United States economic growth, and trying to account for the key factors that drive U.S. growth. His very exhaustive and detailed estimates of growth patterns and growth causative factors led Denison to conclude "that advances in knowledge," which he considered to be primarily technology, accounted

for 34 percent of the growth rate of the United States in the post-war period. It was the largest single factor driving U.S. annual economic growth, more important than the labor input or the education per worker, more important than resource allocation, and many of these other factors.

Technology for the United States has been the decisive growth driver in the post-war period. U.S. Government international science and technology policy must respond to this new global context. The policy prescription in our opinion is clear. Government must seize the opportunity to promote international technology cooperation. Rising R&D costs and steep learning curves demand strategic cooperation—partnerships to achieve critical mass, share costs and risks, and otherwise cross-fertilize technology.

As the cost and pace of research and development increase, transnational strategic alliances will become essential. American companies are already teaming with foreign partners. In the prepared statement I cite a number of examples, including the recent announcement of technology agreements between AT&T and NEC and Mitsubishi.

In tandem with these private technology partnerships, the United States Government should foster equity in the flow of technology and facilitate comparable access, which we consider to be the litmus test of technological cooperation. Specifically, government can negotiate for equity in both trade and science and technology agreements, then follow up on these agreements to ensure mutual benefits are realized.

Congress and the Executive Branch have affirmed on a number of occasions the importance of equitable international flows of technology. The 1988 Trade Act, for example, establishes "equitable access to technology" as a priority negotiating objective of the United States in bilateral and multilateral trade talks. This provision, authorized by Senators Chafee and Bentsen and Representatives Wyden and Frenzel provides legal authority for the United States Government to negotiate for equitable technology flows. I might add that our former Chairman and founder of Control Data Corporation, William C. Norris, was very strongly supportive of that amendment in the 1988 Trade Act.

In addition, the Public Law 100-418 amendments to the State department authorization declare to be the policy of the United States equity of access to R&D opportunities and of the flow of technology.

Congress intended science and technology agreements to be a central focus of these provisions. Indeed, the U.S.-Japan Science and Technology Agreement, in both the preamble and in Article I, commit the parties to "comparable access" to research and development and to the principles of "mutual and equitable benefits."

Negotiating to insert equitable access language in international agreements is necessary but by no means sufficient. The ball cannot simply be left in the court of the private sector after the negotiations. Government should also aggressively facilitate and implement U.S. access to foreign technology.

For example, to the best of our knowledge, no Government agency measures and tracks international technology flows. Therefore, we have almost no idea what the sectoral of balance is in this

critical precursor of goods and services trade flows. The best data we have seen on this subject is put out by the Science and Technology Department of the Prime Minister of Japan's office.

Legislation should authorize the Commerce Department to measure international technology flows in and out of the United States and cooperate with agreement partners to construct appropriate data bases. This will be exceedingly difficult, because the very nature of technology does not lend itself to easy measurement, but one can track the licensing and royalty flows and so on.

In addition, Government agencies such as the Commerce Department and NSF can facilitate follow-up by U.S. companies. At a minimum, legislation should mandate the creation of private sector advisory bodies, as in the U.S.-Japan Science Agreement. Also, agency outreach efforts can encourage companies to be informed and exploit new opportunities.

In this connection, I would add that the small business sector of America especially needs to be reached out to by the Federal agencies to involve them in some concrete way in international technology cooperation. They are a tremendous font of innovation in America, and at the same time a prime target for technology acquisition efforts on the part of other nations through direct investment. They really need to be built in, somehow, and given the opportunity to benefit from acquired technology from our trading partners.

Together with the private sector and university research centers, Federal agencies can identify bilateral cooperation projects, and on a government to government basis, cultivate mutually beneficial technology linkages. The Commerce Department's new Under Secretary for Technology is well positioned at the intersection between government and industry to build these bridges.

In this connection, it is critical that the U.S. Government give high priority to the protection of American intellectual property rights. Our Government must approach other governments, if necessary in the context of S&T agreements, to provide effective protection for these assets under intellectual property laws.

Indeed, the establishment of fundamental principles for appropriate national and international protection of intellectual property rights is essential for the promotion of technology flows and for economic development based on technological advances.

Finally, I should like to address the relationship between S&T agreements and U.S. foreign policy. Our Government should be cautious about entangling international technology cooperation in broader foreign policy objectives. America's urgent need to achieve equity in the international flow of technology through cooperation should not compete with our Nation's foreign policies. The objective of reciprocal access to technology should stand on its own economic merits, not subordinated to America's foreign or strategic policies.

For this reason, the Committee should authorize a cooperative role for USTR, NSF and, of course, for the Commerce Department's Under Secretary for Technology in the negotiation and implementation of bilateral and multilateral S&T agreements. The objective of equitable access to technology has now been enshrined in law. Government can help achieve that goal by recognizing the globali-

zation of technology and fostering international science and technology cooperation.

Thank you very much.

[The prepared statement of Mr. O'Connell follows:]

STATEMENT OF

JAMES J. O'CONNELL

DIRECTOR, INTERNATIONAL TRADE POLICY

CONTROL DATA CORPORATION

BEFORE THE

SUBCOMMITTEE ON INTERNATIONAL SCIENTIFIC COOPERATION

COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY

U.S. HOUSE OF REPRESENTATIVES

APRIL 4, 1990

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Mr. Chairman, thank you for the opportunity to share our thoughts on the subject of international technology flows and science and technology agreements. We commend you for focusing on this subject, which has important implications for US competitiveness and international cooperation.

This committee has done much to support US technological leadership and strengthen America's research and science base. In particular, the committee inspired enactment of the 1984 National Cooperative Research Act. This legislation has helped to evolve a culture of cooperation that will materially leverage R&D investment in America.

Some 150 joint ventures have registered under that law in fields ranging from microelectronics and communications to space and medical research. Had it not been for the work of this committee it is doubtful that the National Cooperative Research Act would now exist.

Today I would like to address our government's role in implementing international science and technology policy. The key points of my remarks are: one, equity must be built into the negotiation of international trade and science and technology agreements; and two, the US government must act as the facilitator in implementing equitable technology flows and cooperation with our trading partners.

Bilateral and multilateral agreements should contemplate the inflow of scientific and technological information, as well as the outflow. Access to government-sponsored projects and facilities and licensing opportunities should be comparable. In short, our objective should be mutually beneficial international science and technology cooperation.

Negotiating to achieve equitable technology flows recognizes a new competitive reality: the US and the world have entered an era of "internationalization" or global diffusion of technology. Technology has become a "fluid organism"; it does not respect national borders.

Similarly, the U.S. government cannot "protect" our technology leadership or stop its outflow. Governments must not try to build walls to block access to fundamental knowledge. Technology nationalism not only does not work; it could prove counterproductive. We should strive instead for balance--for a two-way street in technology transfer.

The reality today is that the US is no longer self-sufficient in technology. The accelerating pace and complexity of technological advance; increasing international parity; and the enormous increase in R&D expenditure required to develop new generations of products have dramatically changed America's relative position.

Our international comparative advantage in technology--which has been the key to our global competitiveness in many industries--is now shared with competitors. After decades of transferring up to six times more than we acquired, America's technology competitiveness increasingly will be influenced by our ability to acquire technology from abroad.

US government international science and technology policy must respond to this new global context. The policy prescription is clear: Government must seize the opportunity to promote international technology cooperation.

Rising R&D costs and steep learning curves demand strategic cooperation--partnerships to achieve critical mass, share costs and risks, and otherwise cross-fertilize technology. As the cost and pace of research and development increase, trans-national strategic alliances will be essential.

American companies are already teaming with foreign partners. Technology cooperation agreements exist between ATT and NEC and Mitsubishi; Intel and NMB Semiconductor; Motorola and Toshiba; TI and Hitachi; and Sony and AMD. There has been discussion of a linkage between Sematech and JESSE, the European semiconductor project. In these arrangements, companies expect to acquire as much technology as they give--they practice the principle of equity.

In tandem with these private technology partnerships, the US government should foster equity in the flow of technology and facilitate comparable access: the litmus test of technological collaboration. Specifically, government can negotiate for equity in both trade and science and technology agreements, and then follow up these agreements to insure that benefits are realized.

Congress and the Executive Branch have affirmed on a number of occasions the importance of equitable international flows of technology. Key provisions of the 1988 Omnibus Trade and Competitiveness Act, the Rockefeller-Dole Amendment to the Federal Technology Transfer Act, the 1988 US-Japan Science Agreement, and the 1986 US-Japan Semiconductor Trade Arrangement make equity or comparable access a principal objective of US international trade and technology policy.

The 1988 Trade Act, e.g., at Section 1101 (b) (15), establishes "equitable access to technology" as a priority negotiating objective of the U.S. in bilateral and multilateral trade talks. This provision, authored by Senators Chafee and Bentsen and Representatives Wyden and Frenzel provides legal authority for the US government to negotiate for equitable technology flows. I might add that William Norris, founder of Control Data, and our company's

leadership urged and strongly supported the Chafee-Wyden initiative.

And the P.L. 100-418 amendments to the State Department authorization declare to be the policy of the U.S. equity of access to R&D opportunities and of the flow of technology.

Congress intended Science and Technology Agreements to be a central focus of these provisions. Indeed, the US-Japan Science and Technology Agreement incorporated equitable access principles. The Preamble and Article I commit the parties to "comparable access" to research and development and to the principles of "mutual and equitable benefits."

Negotiating to insert equitable access language in international agreements is necessary but not sufficient. The ball cannot simply be left in the private sector's court after the negotiations. Government should also aggressively facilitate and implement US access to foreign technology.

For example, to the best of our knowledge no government agency measures and tracks international technology flows. We have almost no idea what the sectoral balance is in this critical precursor of goods and services trade flows. Legislation should authorize the Commerce Department to measure international technology flows in and out of the US,

and cooperate with agreement partners to construct appropriate data bases.

In addition, government agencies such as the Commerce Department and NSF can facilitate followup by US companies. At a minimum, legislation should mandate the creation of private sector advisory bodies, as in the US-Japan Science Agreement. Also, agency outreach efforts can encourage companies to be informed and exploit new opportunities.

Together with the private sector and university research centers, these agencies can identify bilateral cooperation projects and, on a government-to-government basis, cultivate mutually beneficial technology linkages. The Commerce Department's new Under Secretary for Technology is well-positioned at the intersection between government and industry to build these bridges.

In this connection, it is critical that the U.S. government give high priority to the protection of American intellectual property rights. Our government must adopt a tough negotiating stance bilaterally and multilaterally because non-US firms have illegally acquired and applied US intellectual assets. Our government must approach other governments--if necessary in the context of S&T Agreements--to provide effective protection for these assets under intellectual property laws. Indeed, the establishment of

fundamental principles for appropriate national and international protection of intellectual property rights is essential for the promotion of technology flows and economic development based on technological advances.

Finally, Mr. Chairman, I should like to address the relationship between S&T Agreements and US foreign policy. Our government should be cautious about entangling international technology cooperation in broader foreign policy objectives. America's urgent need to achieve equity in the international flow of technology through cooperation should not compete with our Nation's foreign policies. The objective of reciprocal access to technology should stand on its own economic merits, not subordinated to America's foreign or strategic policies.

For this reason, the Committee should authorize a cooperative role for USTR, NSF and, of course, for the Commerce Department's Under Secretary for Technology in the negotiation and implementation of bilateral and multilateral S&T agreements. The objective of equitable access to technology has now been enshrined in law. Government can help achieve that goal by recognizing the globalization of technology and fostering international science and technology cooperation.

Mr. BROWN. Mr. O'Connell, you cited Denison's contribution to the area of economic growth. I have been racking my brain for the name of a recent Nobel Prize winner in economics who also did research on that same subject.

Mr. O'CONNELL. Solow—Robert Solow of MIT.

Mr. BROWN. That's right. My recollection was that his thesis was that it contributed even more than 34 percent, but I could be misrecalling that.

Mr. O'CONNELL. You are obviously more current on the profession than I am.

Mr. BROWN. I wouldn't say that at all.

Mr. BROWN. All right, Dr. Trivelpiece, it is a pleasure to have you before us again. You bring a unique perspective to this problem. Let's hear your statement.

STATEMENT OF ALVIN W. TRIVELPIECE, DIRECTOR, OAK RIDGE NATIONAL LABORATORY

Mr. TRIVELPIECE. Mr. Chairman and members of the Subcommittee, I am honored to appear before you this morning.

The Chairman's letter inviting us to testify asked many questions, more than can be answered in a few minutes of oral summary. I have tried to answer those in my prepared testimony.

I want to focus on just a few points, fewer points than I intended, because like the circumstances of sitting in a group at dinner where everyone is going to talk, you find the points you were going to make have been made by the preceding speakers. I certainly agree with the things that Dr. Gomory, Professor Pollack and Mr. O'Connell have said.

As batting cleanup, I would like to pick up on a couple of things. I want to amplify just a little bit on one of the things that was remarked about, the rate at which science knowledge goes around the world, just to remind you that the discovery of a laser was made by Ted Maiman, and the only information anybody needed to know was that it had been done, and that he did it. Literally within a matter of days, scientists and engineers all over the world had duplicated that result, some of them almost got into print ahead of him.

The same thing is true about high temperature superconductivity. During the time I was with the Department of Energy, it was getting almost difficult to give money away to get people to work on high temperature super conductivity. Then Bednorz and Mueller from IBM made this discovery, and literally within a matter of days, the discovery had been improved upon, and communicated all over the world—the Soviet Union, China and everyone had done the same thing.

Mr. BROWN. Didn't we hear the same statement made about the nuclear bomb, the biggest secret was the fact that it would work?

Mr. TRIVELPIECE. I am sure that's true, yes. Probably also the same with radar, radar was one of the major wartime secrets. The fact that it could be done was the critical element of it.

Cold fusion last year became one of the participants in that activity. I think there were hearings held before the first paper could even get into print, which is another illustration of the speed.

There is a distinction to be made between science and technology, as Dr. Pollack said. Technology moves much more slowly, science moves almost instantaneously. There needs to be a distinction made between the two in your thinking and preparing legislation. I just wanted to remind you with those examples.

You are absolutely right about Bob Solow. I was surprised that one of the remarks Ralph Gomory did not make, which I have heard him make in the past, is quoting Dr. Solow, who basically said that science and technology, not capital formation, are the engines of our economy. I think that's very true, and what we need is a level playing field in dealing between the United States and other countries.

One thing I have found interesting is that Mr. Mitterand, when he was invited to host the economic summit in Paris, at Versailles, established a working group on science, technology and growth. I had the good fortune to be the chairman of two of the subcommittees associate with that activity. It struck me as being quite appropriate that science and technology should be a part of the economic summit. I did not reckon with the attitude of the so-called Sherpas, who worked for that activity. Their attitude was that science and technology probably should not be.

It took them about three years to root the technology growth and employment group out. I am sorry they did. I think it was a mistake. I think science and technology should be a part of the economic summit, and to the degree Congress can encourage the Administration to do that, I think it is a good idea.

Another point I wanted to make that my colleagues ahead of me did not is illustrated by some people who are in this room right now. There are science counselors from several nations attending this hearing. Some of them are scientists in their own right, and have independent scientific backgrounds.

Without any particular criticism on our science counselors overseas, many of whom—almost all of whom—I know personally, and many of whom have been a great help to me. But most of them are not working scientists, or have not been working scientists. I think this asymmetry works to the disadvantage of the United States, and that the United States should seek to have counselors overseas that are working scientists in one form or another.

I know the State Department has changed its position on this, but they still have not made much progress in trying to do it. To make that a possibility seems to me to be important.

The issue of large facilities has come up. In each case, the question of costs comes up. I would like to approach it from a slightly different perspective, and that is that to make progress in certain areas of basic research at the frontier, facilities are needed now, the size and scope of which is substantially greater than that needed for past research.

As a result, there occurs a situation in which you might ask does it make any sense for several countries to build the same facilities to get the same scientific result at the same time for $4 or $5 billion? I think it is outrageous. It should not occur. Competition does not make any sense in that particular regard.

Clearly, some form of cost-sharing would make great sense. But the idea that it is not possible to afford it financially is not as trou-

bling to me. I believe that they can be afforded. It is the poor use of scientific talent that bothers me. The more precious commodity in this regard is the scientific talent of the scientists and engineers that would participate in such a program. So what you want is to try to find a basis whereby country A could fund facility 1 in collaboration with other countries to make it available for the use by all in a way that the participants share the information.

Then, five years later or ten years later, country B builds facility 2, and you can do this in a way that international units of account are taken into account in trying to determine what constitutes the quid pro quo. But the idea that there should be a detailed balance—quid pro quo, year by year, country by country—to me doesn't make any sense. We should try to go on a broader basis for these kinds of things.

One of the things that I talked about in some conversations with Dr. Gomory before the hearing that he did not mention in his testimony is that from time to time the United States suffers a reputation for being an unreliable partner—solvent refined coal, space stations—there are lots of things that give us a black eye. There are good and sufficient reasons economically why these things are altered or turned off. But it does not improve our relations. To the extent we can maintain stable continuity of purpose in dealing with other countries in science and technology agreements that our own reputation will be substantially enhanced. I hope that we can do that, become a stable and reliable partner.

The national laboratories I think will begin to plan an expanded role in these activities. They serve as a natural host for certain types of international activities that has grown, but like Dr. Gomory said, the need is for sending people the other way. We have quite a few people coming into the United States. What we need is to send American scientists and engineers overseas. Any type of legislation you can make that would facilitate or encourage that would be greatly to the benefit of the United States.

With that, Mr. Chairman, I will conclude and be available for any questions you may have.

[The prepared statement of Mr. Trivelpiece follows:]

TESTIMONY
SUBCOMMITTEE ON INTERNATIONAL
SCIENTIFIC COOPERATION
April 4, 1990

Alvin W. Trivelpiece
Oak Ridge National Laboratory

Mr. Chairman and Members of the Subcommittee, I am pleased to have the opportunity to testify before this Subcommittee to present my views on international science and technology policies. I had the good fortune in 1958 to be a Fulbright Scholar at the Technische Hogeschool in Delft, The Netherlands. In 1980 I became Director of the Department of Energy's Office of Energy Research. In 1987 I became the Executive Officer of the American Association for the Advancement of Science, and am now the Director of the Oak Ridge National Laboratory. The opportunities afforded by these positions for interactions with scientists of other nations has deepened my appreciation of the need for international cooperation. I believe that the United States has a great deal to gain by the appropriate involvement in international cooperation in science and technology. The organization of my testimony will provide my perspective on international science and technology policy and then focus on the particular questions contained in the Subcommittee's invitation.

Perspective on Science and Technology Policy

Science and technology are playing an increasing role in economic development, both in the United States and elsewhere in the world. Robert Solow of MIT, the 1987 Nobel Prize winner in economics, has studied the economic impact of science. In an interview (United Press International, October 21, 1987) he stated, "What I got interested in was the question of what makes a modern industrial economy grow...we owe it all to the growth of science and technology." This comment reflects the important role science and technology has in our economic well-being. Solow demonstrated that only a small portion of annual growth could be

explained by increases in labor and capital. The key factor was always technology. When these results came out in the early 1950s, they had a great impact on people's thinking. More emphasis was placed on higher education and technological research. In describing Solow's work, Professor Karl-Goran Maler of the Stockholm School of Economics and a member of the Nobel selection committee said, "Solow showed us that in the long run it is not the increase in quantity that is so important. It is the increase in quality, through better technology and increased efficiency. Better technology will be the engine for increased growth." (New York Times, October 22, 1987, page D1)

The United States is not the only nation that gives science and technology a high priority. As telecommunications have improved, news of scientific discoveries and technological breakthroughs has quickly spread worldwide. For this reason, it is impossible to stop science from crossing international borders. Several significant examples of this rapid dissemination include the laser, high temperature superconductivity, and cold fusion. The laws of science are available to everyone. Frequently all that is needed is the knowledge that a process works. With the laser, all that one needed to know was that a lasing had occurred and that it had been done using ruby. Many then did go into their laboratories to duplicate the results and study the phenomenon. After many years of no progress in the laboratory, J. G. Bednorz and K. A. Mueller discovered ceramic rare earth compounds that were capable of higher temperature superconductivity. This set off a spate of activity in which not only the results were duplicated but also improvements were made in an incredibly short time. The announcement of cold fusion stimulated a great deal of activity to duplicate the results. How did news of these discoveries spread? News reports and personal contacts clearly played a more significant role than traditional scientific journals in the initial, rapid dissemination of results.

Any policy that is developed regarding science and technology must take into account both the effect of science on national economies, and the speed with which discoveries are communicated around the world. I believe that science has also been a mechanism for international

communication during times of political stress between countries. It is my belief that contacts between our scientists and those in the Soviet Union and the People's Republic of China have contributed to improved diplomatic circumstances.

Title V of Public Law 95-426

Among other things, Title V of P.L. 95-426 designates the Department of State as the lead agency with respect to science and technology agreements. Scientists cooperate in different ways. First, there is the scientist-to-scientist exchange of information within or outside of an international organization. Second, there is an institution-to-institution agreement where a sister laboratory is involved. Oak Ridge National Laboratory has several of these agreements with foreign scientific institutions. These are not much different from any arrangement we have with institutions in this country. Third, there is an agency-to-agency relationship, such as that of the Department of Energy with its counterpart in some other country. The Department of State has a prominent role in this activity. Clearly this is appropriate where many requirements are present for the development of agreements. Fourth, there are agreements between governments, in which the Department of State frequently takes the lead.

The interagency process which defines U.S. policy in the science and technology area is working very well. Each agency which has an interest in a particular agreement is included in all preliminary discussions. Their views are incorporated into the final policy proposal. The purpose underlying their inclusion is to ensure scientific, security, and political/economic concerns are all addressed. I believe this purpose is being achieved. The annual report to Congress mentioned in section 2656d of Title V is very significant. I am not aware of any other document which organizes all of our science and technology agreements so effectively.

Recently, the Oak Ridge National Laboratory hosted 14 science counselors from 13 countries. These counselors are members of the diplomatic staff accredited to embassies in Washington, D.C. Their responsibilities include

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monitoring science and technology in the United States. During my recent tenure in Washington, I became aware that this group had an incomplete understanding of the role of the Department of Energy's national laboratories. Their visit to ORNL gave them the opportunity to view first hand our activities in robotics, waste management, spectroscopy and microscopy, materials science, nuclear energy, and environmental science. All of these diplomats have formal science or technology backgrounds, some to the Ph.D. level. I believe it is important for our diplomats in similar positions to also have these credentials, and I encourage the Department of State in this effort. Perhaps this background will allow the Department of State to have an increased awareness of the science and technology activities of the private sector and multilateral development banks.

It is the responsibility of these science counselors to communicate their observations to organizations in their countries. Although everything they see and read is public knowledge, their active participation in the United States science scene is highly beneficial to their countries. I am not aware of dissemination of trip reports made by our Department of State that reach the private sector. Perhaps the best known assessment of overseas scientific activity is the European Science Notes Information Bulletin published by the Office of Naval Research European Office. Although I don't have any particular mechanism in mind, the United States scientific community needs to be aware of current research throughout the world on a more real-time basis and not restrict itself to reading the scientific literature which can be many months out of date when it is published.

Federal Laboratories

The number of federal laboratories exceeds 700, if you include all of the laboratories of agencies like the departments of Agriculture and Energy, the Environmental Protection Agency, and the Institutes of Health. These laboratories are implementing actions and playing a critical role in looking for opportunities on an international level. For a successful

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international mission-oriented program, a framework must exist for intergovernmental cooperation. The Department of State provides such a framework and leads the negotiations of any agreements with the laboratories and agencies supporting this effort. After the framework is established, the laboratories and their agencies assume the lead role in understanding the area of opportunity and defining what needs to be accomplished. Once the agreement is negotiated, the laboratories take the lead role in executing the agreement.

Just as science is for everyone, technology has specific applications. There have been documented circumstances that certain areas of technology have become available in other ways than we feel is desirable. Several countries have chosen to take advantage of our science and technology base and have used it for their development. Combined with their lower costs of capital, labor, or other economic factors, their economic growth may occur at a faster rate than ours in the United States.

General Accounting Office Report on Technology Transfer

Our national laboratories perform research that is at the forefront of our national effort and consequently act as our nation's international laboratories. According to many reports, such as Workforce 2000: Work and Workers for the 21st Century (Hudson Institute, Indianapolis, IN, 1987), America's Next Crisis: the Shortfall of Technical Manpower (Aerospace Education Institute, Arlington, VA, 1989), and Changing America: the New Face of Science and Engineering (Task Force on Women, Minorities, and the Handicapped in Science and Technology, Washington, D.C., 1989), the United States faces a shortfall of scientists and engineers by the year 2000. National laboratories will be competing with U.S. industry for the best and brightest staff. While much of this shortfall will be made up by attracting minorities and women into these areas, part of it will also be filled by immigration of scientists into this country. While many laboratories have an international flavor now, I expect all of our organizations will continue to rely on citizens of other nations to be part of our national research effort.

If you have a state university that has 80 percent foreign students; the citizens of that state have every right to say that their tax dollars are not being well spent. On the other hand, if there were no foreign students, the children of those citizens would be at a disadvantage for not having the benefit of learning about international cultures from the foreign students. The international effect of science and technology that I mentioned in my overview involves attracting the finest scientists and engineers to our laboratories. The GAO report (Technology Transfer: U.S. and Foreign Participation in R&D at Federal Laboratories, report GAO/RCED-88-203BR) states that "managers and administrators at the eight federal laboratories we visited opposed establishing a government-wide policy that restricts or excludes access of foreign researchers to fields of research or facilities because of the commercial potential of the technology...their laboratories have sufficient authority to control foreign access and/or the policy runs counter to the scientific principle of free and open access and discussions among researchers seeking to advance scientific knowledge... restricting foreign access would be counterproductive" (page 51). I agree with this. The openness of the national laboratories is paramount if the United States expects symmetrical access to facilities, intellectual property, and patents in other countries. The United States gains overall if we can have their scientists visit our science facilities as well as the capability of sending our staff to science facilities in other nations.

Even so, when our government enters into international science and technology agreements, we must now be aware that these agreements also reflect technology and trade implications. With the increasing private sector investment in university and federal laboratory R&D, poorly conceived agreements could allow foreign competitors free access to research of great commercial value which has been largely funded by our private sector. The obvious effect will be to discourage the private sector from entering into cooperative arrangements with federal laboratories, thus defeating the objectives of the Federal Technology Transfer Act before it has a chance at life.

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This new reality simply suggests that the government must strike a balance between the objectives of international scientific cooperation and the objectives of good technology management. There is not an inherent conflict between the two, just a need to enter these agreements with our eyes open.

Burden-sharing of Big Science Projects

The idea that several nations should simultaneously build a $3 billion or $5 billion facility to seek the same scientific results is outrageous from a financial point of view. Even if the countries (and their scientists) would do such a thing, it is a poor use of human talent. Over the long run, human talent will become a much more precious commodity than the cost of any "big science" project. It would be desirable to develop a system whereby, with trust, nation A would agree to build Facility 1. They would be joined in cost and talent by others, and the resulting scientific information would be mutually available to all who participated. Nation B might be expected to do the same with Facility 2, which would be in some sense similar in scope and character but not necessarily in the same scientific area or the same timeframe. These units of account would stretch over decades, not months or a few years.

CERN Laboratory in Geneva, which engages in high energy physics, is an excellent example of international collaboration which meets the needs of many nations. Similarly, the Joint European Torus (JET) project in Great Britain also meets multinational needs. While still in the conceptual design phase, the International Thermonuclear Experimental Reactor project will require agreements greater in scope than CERN or JET because of the involvement of the Soviet Union, Japan, and the European Community with the United States.

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Equity in Technology Flow

The intent of our laws is to ensure symmetry in the flow of technology. Legislation, such as the Omnibus Trade and Technology Act of 1988 (P L 100-418), appears to be adequate for this purpose. Our numerous agreements covering science, technology, and energy issues with Japan indicate that, over the years, this has been the case.

The Department of State should have its traditional coordinating role in multilateral or bilateral discussions of technology flow. Other agencies, including the Department of Commerce, Department of Energy, Department of Defense, and the National Science Foundation, are deeply involved in dealing with questions of equity in the flow of technology. This results from their participation in the interagency review process that covers all proposals for international science and technology agreements. This interagency process ensures an appropriate balance is maintained, including a balance in the area of intellectual property rights.

Over the past decade, several National Academy panels have examined the effects of national security export controls. The Panel on the Impact of National Security Controls on International Technology Transfer, in their report Balancing the National Interest: U.S. National Security Export Controls and Global Economic Competition (Lew Allen, Jr., chairman, National Academy of Sciences, Washington, D.C., 1987), studied the current system of U.S. and multilateral national security export controls. It sought strategies regulating international technology transfer to achieve a desirable balance among the objectives of military security, economic vitality, and scientific and technical advance. The panel recommended that the United States exercise stronger leadership in building a multilateral community of common controls for dual use (both commercial and military) technologies among cooperating countries. This involves eliminating certain controls on trade and developing other effective control arrangements with technologically advanced nations. The Panel also recommended the executive branch accord greater importance to maintaining technological strength and the economic vigor and unity of the Western alliance than was currently done. Essentially,

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this Panel called for a broader definition of national security to include economic vitality of Free World countries.

Results of the implementation of this Panel's recommendations were assessed the following year by a group convened by the Aspen Institute that also looked toward the inauguration of a new President. I was fortunate to participate in this seminar and contribute to the report Economic Dynamism and Export Controls: International Technology Transfer in a Knowledge-Intensive World (Aspen Institute, Queenstown, MD, 1988). This report recommended that allied solidarity on security export controls be achieved soon after the new Administration takes office. Progress has clearly been made in areas suggested by the Lew Allen report. Continued attention needs to be focused on the recommendations of these two panels.

Intellectual Property Rights

From my experience, both the Department of State and the technical agencies believe that American intellectual property rights should be vigorously protected. How can this best be accomplished? There appears to be a divergence of opinion within the government as to how the competitive position of the United States can be maintained and advanced in science and technology. The Department of State insists on the inclusion of detailed intellectual property rights language in agreements it negotiates. It has done so over the past several years. However, only the technical agencies on whose behalf these agreements are concluded can subsequently determine that these rights are properly allocated and protected in practice without side effects that are counterproductive to their mandated interests. These technical agencies are the parties best qualified for that job: they have the expertise to know the intellectual property in a particular field. As the actual partners in the implementation of the agreements, they will also know when intellectual property has been created or furnished.

To do their job properly, the technical agencies must have the legal authority and the flexibility, in terms of both U.S. law and international commitments, to make decisions freely recognizing the varying circumstances of their foreign partners. A science and technology relationship with country A, which has protections equal to or more stringent than ours, and which has information that can be of more value to us than ours is to them, should be significantly different from our relationship with country B, which may adopt our technology without proper compensation and is protected under their laws.

By adhering to a strict set of intellectual property rights in all international science and technology agreements, we run the risk of inhibiting the free flow of scientific information. This may not only be impractical but may also have negative results. Potential foreign partners which are of major scientific or political importance to the United States may refuse to enter into such agreements. This may cut us off from potentially valuable technical and foreign relations benefits. Insistence on rigid provisions can be counterproductive and result in taking away from U.S. agencies and our private sector the same rights we seek to establish.

U.S. Collaboration

When I was at the Department of Energy, I often received delegations from other countries that were interested in determining how priorities in science and technology were established in the United States. My answer was that there was not a single policy but a collection of policies based on individual programs. Each agency tried to support those areas that it thought were the best. This led to both sensible priorities on a program basis and to a lack of overall coordination. Is that bad? This method contributes to effective science in the United States. When dealing with science and technology on a government to government basis, I can understand why the Ambassador may think it is "arbitrary."

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Because we have a four-year presidential cycle and a one-year budget cycle, this allows for potential "inconsistency" in the budgeting of projects. These cycles are fundamental to our system, yet some mechanism is necessary to extend support for domestic projects beyond one year.

International science and technology agreements are primarily based on the good faith and understanding of all parties involved. Occasionally, decisions are made affecting these agreements that, in fact, appear to be "arbitrary." Many of these decisions are the result of financial stringencies that could not have been foreseen at the time the agreements went into effect. On a number of occasions over the past decade or so, the United States has changed its funding position on international projects. Decisions regarding Solvent Refined Coal, Intense Neutron Source, Fusion Materials Irradiation Test, Large Coil Test Facility, and the Fast Flux Test Facility were economically justifiable in terms of the costs to the United States' programs and other budget priorities. However, significant distress was felt by our international partners. It does not take many events such as these to arouse fears that our actions are arbitrary. Because they are part of the budget process, the options under consideration need to remain secret until the budget is sent to Congress. Can agencies receive assurances from the Office of Management and Budget that our international agreements will be honored? Probably not, unless these agreements are elevated to the status of a treaty. I understand that environmental consequences of budget items are required to be mentioned during budget preparation. Perhaps it is also necessary to include the international consequences of our proposed actions in the budget. Our international colleagues are now asking us the meaning of our agreement to participate in projects. If the United States expects to invite international collaboration in its projects, it must consistently uphold its part of the deal.

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Other Opportunities

The unique advantage which the Department of State possesses is its knowledge of and sensitivity to the technical and political interests of our foreign partners and potential partners. The Department of State is in the best position to determine when and where opportunities exist for cooperation and burden sharing. It has an excellent track record in identifying and exploiting such opportunities.

The lack of adequate financial resources is one factor which makes exploitation of these opportunities uncertain. Neither the influence nor the credibility of the United States can be successfully developed without adequate funding. The Support for the East European Democracy Act of 1989 (P.L. 101-179) authorizes appropriations for science and technology exchanges with Poland and Hungary for a total of $2 million in 1990. Even this modest amount is reduced by section 614 of the Department of State Appropriations Act of 1990 (P.L. 101-162). Although SEED appropriates $300 million, that amount has been said to be small compared to the total economic development needs of those countries. I earlier mentioned that "Better technology will be the engine for increased growth." Wouldn't the return on our investment be greater if 10 percent of the total appropriations, or $30 million, were to be spent on upgrading the scientific and technical communities of those countries? The impact of this investment on the scientific community would be substantial.

Another factor limiting our ability to take full advantage of our opportunities is the use of science and technology agreements to advance our political and technical goals. There probably are opportunities being missed by the United States regarding burden sharing in science and technology. In some cases appropriate, and in some cases misguided, efforts to prevent the flow of technology from the United States have probably resulted in the prevention of agreements and exchanges that would have been benefited the United States and other countries.

Additional efforts for international cooperation abound that offer the opportunity for burden sharing. I believe animals can be used for certain

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types of research trials that lead to the reduction of disease. However, the idea that different sets of animals need to be used in different countries to get the same information seems foolish to me. Information and research results should be shared across national borders to minimize the use of animals in research.

Conclusions

Science and technology are dynamic international activities. The hallmark of our national strength is our capacity to produce, and disseminate knowledge. Our nation does very well in acquiring knowledge from domestic sources but there are tremendous opportunities for collaboration through international agreements based on symmetry. Our expanding environment allows the United States to increase its economic well-being through technological advancement. Rigid and uncompromising positions on intellectual property rights can cost our country dearly in the global competitiveness battle.

Mr. BROWN. Thank you very much, Dr. Trivelpiece.

Let me express my thanks to all of you. I think your statements are excellent. It is a little difficult to know where to start, actually.

Dr. Trivelpiece, you have mentioned that there are something like 700 national laboratories scattered throughout the Government. They are looking for opportunities on an international level. Is there any mechanism within the laboratory structure itself for their sharing of science and technology? Before we start looking at how well we share our scientific resources with other countries, is there a mechanism in place?

Just to start with, your sharing with the Department of Energy laboratories, a vital national resource, but does the Department of Energy labs share their work with the Department of Defense lab, and Department of Agriculture labs? Is there a mechanism for doing this? Is there a way to communicate on a real time basis?

Mr. TRIVELPIECE. There is no prohibition against it. There probably, in the sense that you are asking the question, there is not a formal mechanism that requires or mandates that, but it certainly takes place on a wholesale basis. It probably occurs in one of the proper ways, a scientist to scientist exchange.

There are indeed scientists and engineers who come to Oak Ridge, for instance, that work on programs at the laboratory. There is also a work for others program, which is a useful element of technology transfer. In other words, the Department of Energy, at that laboratory, does about 20 percent of its work for other Federal agencies, such as NIH, the Department of Defense. It is a natural mechanism which takes place there.

Each agency, of course, has a certain degree of independence. The Department of Agriculture funds its own laboratories.

The answer to your question is that no formal mechanisms exist. It does work, it could work better. It is a perfectly legitimate concern, that we do it well enough internally. We certainly do not do it well enough internally between national laboratories and industry. There I think the problem is simply moving people back and forth. It would be highly desirable for scientists and engineers from national laboratories to work in industry for a while, and vice versa.

There are some barriers to that, the barriers are getting smaller. But I think that's the way in which technology transfer takes place, and to the extent that that same algorithm could be applied to other laboratories, both Department of Defense, Agriculture and NIH, that would be a good idea.

Mr. BROWN. I think it would be a good idea, also, and I haven't seen too many signs that it actually works. I suspect that at the Department of Energy you have lots of inter- laboratory collaboration. But I will bet you that somebody who reads the IEEE Spectrum very rarely reads the Journal of Agronomy, or something of that sort that would be important to an agricultural scientist. I am concerned whether these interdisciplinary exchanges can be facilitated in some way.

Mr. TRIVELPIECE. They should be. Almost everything that is interesting that happens in science today is somehow interdisciplinary. The traditional boundaries of physics, chemistry, mathematics and so on provide barriers that prevent more effective research

in some areas. To the extent that any of these laboratories can serve as a facilitator for interdisciplinary activities, they should be encouraged or even made to do so.

Mr. BROWN. Dr. Gomory, you and Professor Pollack both take a rather—I don't want to say cynical—approach to this business of international scientific cooperation. I think it is your view, Dr. Gomory, that the changes that are occurring in the world today are making it easier for informal scientific contacts to be made that business and industry are becoming increasingly internationalized and providing a vehicle aside from government that works very well.

Professor Pollack, you are a little more cynical, I believe. You seem to take the view that S&T exchange agreements are largely a substitute for more effective cooperation in other areas. You mention that we will send our science advisor to Pakistan to help with the water problem, I guess in lieu of doing something else, to encourage better relationships with Pakistan.

Is that a correct reflection of your views, that these agreements are not all that important, but they are symbolic?

Mr. POLLACK. The fact that they are symbolic does not make them less important. No, I think they are terribly important. They are very major political instruments, not only for this country, but for others. But if you want to do science, don't ask the Government to be the vehicle for doing it. If that's what you are looking for, then you have an open field for criticism from now until midnight.

Mr. BROWN. My observation over the last 20 some years has been sort of in agreement with what you stated. I used to be very much interested in S&T agreements with Mexico and Latin America, for example. I observed that we would sign one, a new president would come in in either Mexico or the U.S.—we would sign a new one, and nothing would happen until another president came in and we would sign another one.

That's not really very encouraging. We really do need tremendous interaction for our mutual benefit within the western hemisphere.

Mr. POLLACK. I could not agree with you any more. In 1974, it stands out in my mind because that is the year I left the State Department, I came back as a consultant to work on a program that Mr. Kissinger had initiated to establish a U.S.- Latin American Commission for Cooperation in Science. A lot of activity took place, major meetings, lots of trips, and much discussion, etc. That fell apart when the OAS adopted a resolution having to do with the U.S. action—I now can't recall what it was—regarding Venezuela. That initiative then died.

I come here today and see that you have a bill, which by the way I think is an excellent bill, among other reasons because it provides a source of funding, even though you take it out of the pockets of an agency that I think could probably could find a way to squeeze some money out. The need for cooperation, the need for a strategy for dealing with the whole of the inter-American arena has been with us for decades. I wish this particular bill well.

It also is attractive to me because it is not cluttered with a great deal of other things, such as my formal remarks indicate, that Title V has become cluttered with.

I don't think I am being cynical, and I don't think your remarks are cynical, I think they are realistic. If you don't approach this thing realistically, you end up being somewhat off the target.

Mr. BROWN. Let's discuss for a minute the importance of college, science and technology as the driver for economic progress in all the nations of the world. You have cited Denison, you have cited Solow, and of course there is other evidence bearing on this. One of the items of evidence that seems to be the most persuasive to me, and I don't see much attention being paid to it, is the science indicators put out by the National Science Foundation, which show that the growth in resources for R&D in the major industrialized countries.

Japan has gone from virtually zero after World War II up to roughly three percent of the GNP for R&D, Germany has similarly, Britain and France are somewhat level. They were perhaps at a higher level after World War II. The U.S. has actually shown a one-tenth of one percent decline over the last 25 years. Along with those indicators are the balance of trade indicators and the percentage of scientific and technical personnel, or the number per 10,000 population. These are part of the indicators.

In every case, there seems to be a correlation between the resources devoted to knowledge and the increase in GNP and the increase in share of local markets and increase in the number of scientific and technical personnel per 10,000. It seems almost convincing. Why don't we do something about it?

Mr. Gomory?

Mr. GOMORY. The correlation is real. If you look at it in a little more detail, I think one of the reasons why it is difficult to do something about it might emerge. If you would allow me, Mr. Brown.

First of all, almost all R&D is done in the manufacturing sector, all of it outside universities and non-government.

Mr. BROWN. Let me add one other statistic here. As far as the Japanese are concerned, we have an illusion over here that most of the R&D is government-provided. The opposite is true. Eighty percent of it comes from the private sector.

Mr. GOMORY. Yes. And my remarks are really about the private sector.

Comparisons of how intensely you are pursuing R&D should not really be made against a GNP, because most of that GNP is in sectors which do no R&D, but against the manufacturing sector. Secondly, my observation of how R&D is spent is that it is not an independent decision. This affects why it is hard to effect. Very often, it is a derived decision. In other words, if you are in the process of putting out printers or something else, some product, there is very often a rule of thumb, within an industry very often quite uniform, that 25 percent of what you get is required to pay for the manufacturing, eight percent for the R&D and so on.

So if you are successful with a product, and you might be successful because of superior manufacturing, superior quality, superior marketing, superior R&D—anything—you have a larger flow of income and it is eight percent of that that determines the R&D. I would like to suggest the thought that R&D is not an independent

investment decision, but it is a measure of product success which is also another way of looking at why it is correlated.

My second observation vis-a-vis Japan is that the enormous success of Japan in the manufacturing sector has meant that the manufacturing sector as a proportion of GNP has not decreased as much as the American manufacturing sector as a proportion of GNP. That fact alone, because of all R&D being done in the manufacturing sector, explains the changes. To the best of my knowledge, if you look at American R&D expenditures, by industry, you will find that we are as R&D intensive, if not more, in every manufacturing sector. But those sectors have been losing out.

Mr. BROWN. I need to see some more figures on that statistic. I think you are probably right.

Any other comments on this?

Mr. O'CONNELL. Mr. Chairman, I might add that this whole concept of internationalization of R&D may bear directly on your point, that is that we can't look at a concept of R&D sovereignty which those statistics seem to show. I think getting back to your earlier comment, that's where there is a very important role for Government in helping not only to negotiate agreements, and get words into text, but also to have that follow-up that assists companies and universities and small business and so on in capturing the technology benefits developed in those countries you have cited.

Government, I think, plays a very important role also in helping American industry to evolve to a new culture. I might add that this Committee did something very important in 1984 which I mention in my prepared text, when it led the effort to bring about the National Cooperative Research Act and allow R&D joint ventures. The first couple of years under that Act, not much happened. Now there are about 175 such ventures in many, many different fields, including MCC in Austin, Texas, which was the first.

That legislation not only inspired these ventures to come about, but has slowly and surely been changing the culture within companies that derives from the sort of "not invented here" syndrome that Deputy Secretary Murrin of the Commerce Department talked about before this Committee. Our cultures are changing, we are looking for partners now, and we are certainly far more open to foreign cooperation than we have ever been in the past. I think that is an important role Government can play.

Mr. BROWN. Mr. Fawell, I am ready for you to ask questions any time you feel like it.

Mr. FAWELL. As you expressed, I am not sure where you want to start. I hear what you are saying, it seems to me that the U.S., at least as far as basic Government research is concerned, is not too concerned about protecting itself, and that we are not doing the cooperation, engaging in cooperation with other countries. I know when the superconductivity craze — is that the right way to express it?—was going on, I had expressed once in one of these committees that it seemed to me that there was an area for cooperative research, which would be tremendously appropriate, because of the advantage of being able to use frictionless wires. You could ship energy anywhere to the third world, cheap energy, and so on.

Why wasn't science—in the broad sense of that word— more interested in getting together and pooling the talent, so that we could

have had as fast as possible a breakthrough there, because so much good to the world in general could be had. Yet I have always heard, there are great profits to be made here in the commercialization of this, and we have been losing the race there. Notably Japan is always the first one picked out for criticism. If we don't watch ourselves, and have individualism insofar as our superconductivity research is concerned, we will find we will be taken.

I hear you folks saying that who wins the basic research race really doesn't matter that much, that you can catch up, and there are a whole bunch of reasons why I guess our corporations are not doing too well in the applied research. It seems to me that you are also saying that we are, our private enterprises, are catching on, we are adapting ourselves culturally to a world where we are no longer the kingpin, as we were for years and years after World War II, and that private enterprise can do it.

Yet, Dr. Trivelpiece, you said, and I have heard this a lot, that we need a level playing field. We are not so sure we are going to be treated correctly out there by the rest of the world that is not quite as open as we are. Did you not say that?

Mr. TRIVELPIECE. Yes, I did.

Mr. FAWELL. So you feel that is a type of a barrier insofar as our letting our guard down, so to speak, and being open insofar as entering into international agreements without the worry that someone else is going to take advantage of us?

Mr. TRIVELPIECE. I think it is the that level playing field means that we should gain the same opportunity to know what others are doing that they have knowledge about what we are doing. The lack of symmetry is generally speaking on the other side. Some countries have national laboratories which, if we engage in joint research with them, the data that they get from us can go immediately to their industry with some exclusivity protections. Except for some very recent changes in the laws of the United States, that has been impossible to do here. We could not give exclusive licenses to people for research that grew out of our own efforts.

A level playing field, in that sense, is essential. Beyond, that I think the ability to run faster is what provides the security in this.

If I could follow up on another aspect of that, you mentioned high temperature superconductivity. An area that has not come up here is environmental concerns. I made an extensive trip to the Soviet Union this fall, and it struck me as very interesting. Here is an area for which the commercial opportunities are there. On the other hand, the benefit to both countries from the sharing of this information is quite mutual. I am not saying it is the most clever way. The point is if we contribute to something that involves improvement of a pollution control device that the Soviet Union uses and it reduces pollution on a world scale, that benefits us as much as if we did it here in the United States.

This idea of trying to enter into some of these areas involving global environmental concerns strikes me as an absolutely superb area for international cooperation. The main thing is to get people doing it.

Mr. BROWN. Dr. Gomory, I was hoping Mr. Fawell's remarks about superconductivity would provoke some kind of a response from you.

Mr. GOMORY. In response to this popular demand, I really agree with Mr. Fawell's remarks. As a matter of fact, if I might just trace the history of the high temperature superconductivity and where it stands today, I think it illustrates many of the things we have been talking about in a concrete sort of way.

First of all, it is worth remembering that the initial discovery of Bednorz and Mueller was not a U.S. discovery, though, it was done in the laboratory of the IBM Company, a U.S. company, in Europe. Instantaneously, just as Al remarked, enough knowledge of that went around the world that everybody pitched in. Meetings have been held around the world ever since on the scientific progress. It required no government intervention whatsoever, nor could governments, had they strained themselves, prevented it.

It is very important to realize that an awful lot of information flow will take place whether a government facilitates it or not. One of the things I am trying to say is that when you are dealing between two free countries, as we do in the case of the U.S. and Japan, the governmental flows are minor compared to those that actually occur.

The other dimension of that though, we are saying that basic research does not relate to competitiveness. Yet, superconductivity does. The decision is along a fine line. The Japanese do get themselves well organized to try to relate these scientific discoveries to industrial use. Then they will likely get there ahead of us. But that doesn't really point to something we should do to them, it points to something we should do better at home.

That isn't negotiating an equal access anything. It is using knowledge more effectively. You notice that when Al Trivelpiece spoke about the difficulties of working and the exposures of working with the Japanese national laboratory, if I understood him correctly, he said the problem was that they could make good access to their industry, and we couldn't. Again, the difficulty lies on our side. We have to do better. That we can learn to do. To try and hold back the flow of information, I think is not feasible.

Mr. FAWELL. I had assumed it is the other way around.

Mr. GOMORY. If I might add one more remark in that general direction. We have had some reference here to negotiating equal flows of scientific and technical information. Although I think that is possible between a very undeveloped country or a very regulated country.

If we are thinking industrial competitiveness we are always thinking that the only competitors are the other highly developed free countries. I know of no way that one can negotiate any equal flow, because the flow is enormous, and it is done by tens of thousands of individual actions. You can negotiate all kinds of exchanges, and it won't matter, because it will be sunk in a sea of other things.

Again, I think the way to be helpful in that matter is not to attempt to negotiate equality. Nothing can be done. But the way government can be effective is not so much by negotiating, but by making sure that we on our side sending our people and work at send our people.

Mr. FAWELL. Which we have not done.

Mr. O'CONNELL. Mr. Fawell, may I make one comment about that? I don't think anyone has suggested negotiating for equal flows. I don't think it is possible to measure it in that way. But I think an equivalency or equity of access, a comparability of benefit, these are the kinds of things that ought to be objectives. They could be implemented through cooperation. Our problem on the U.S. side is that we have not been eager enough cooperators. Government can help in that regard.

Mr. FAWELL. But I gather we are catching on and improving, is that not correct?

Mr. TRIVELPIECE. We have a long way to go.

Mr. FAWELL. Are there more international business agreements now, or international R&D taking effect? Wendell Wilkie long ago talked about one world. It has not gotten here—I know it has not gotten here politically speaking. That I am sure of.

But the business entities of this world are the ones that are creating the global economy. If the economy is driven by R&D and they are interested in the economy, it seems to me that maybe in spite of government, this all may take place. We can perhaps rejoice in that. Or is that a foolish statement?

Mr. GOMORY. No, indeed.

Mr. FAWELL. Maybe a government just gets in the way?

Mr. TRIVELPIECE. One of the ways where it does get in the way from time to time, and we will see this in the agencies. There will be a large international meeting, and there will be a proposal that 100 or 200 U.S. scientists go to that. Somebody in the agency says "My gosh, why don't they just send one person, have them take notes and bring back all the information." This then translates into something like 50 people going.

One of the cheaper things the U.S. can do is send scientists overseas to international meetings, whether they give a paper or not. What they bring back is worth its weight in gold, what they make in contacts may over 15 or 20 years pay back rich dividends to the United States. It is one of the stranger false economies the various agencies have. It manifests itself from time to time in orders or edicts that result from some abuse that one individual has made. But quite frequently, everybody else by the miscreant gets punished, and the Government suffers from the loss of information coming back.

To the extent that any of that could be institutionalized in a way that it could not be modified by whim, I think you would be doing a service to the United States.

Mr. FAWELL. I think you are entirely right. The other side of that coin, of course, is when you hold a meeting in the United States and the Government lets the list of attendees be screened by one or more Government agencies, and decisions are then made irrelevant to the meeting about who can or cannot attend.

The problem that poses is not so much the individual action, but the understanding that we do not invite people who might be a problem. So your attendance becomes self-defying.

Mr. TRIVELPIECE. It has a chilling effect.

Mr. FAWELL. Yes, it has a chilling effect.

Mr. FAWELL. Dr. Gomory?

Mr. GOMORY. Mr. Fawell, I wish I could subscribe to the very annoying picture that everyone shares their R&D and then everyone therefore economically goes ahead at the same rapid rate. I think it isn't quite right. The notions that R&D drives the economy is only partially true. R&D brings the knowledge on which progress is built. In the end, it matters enormously who manufactures.

Therefore, if we have equality in R&D, but for other reasons the products that emerge and are improved by it are not competitive, we will not be the manufacturers of those products, and our economy will not move forward.

So I think we occasionally talk because of our backgrounds and special interest as if R&D alone could drive the U.S. economy. R&D is correlated with progress, believe me, as the Japanese have shown, on a lower level of R&D they have grown their economy faster than we have. There are other factors which tie in with that. If we are going to have a world of shared R&D, we then will have to compete on those other things effectively.

Mr. FAWELL. I recall reading an article where you were quoted rather extensively. It was pointed out that even within your own corporation, at that point, that as far as even one part of your corporation, the engineering part doesn't talk to the people on the floor. The culture of America, a lack of cooperation, is certainly something that would hold up the flow of R&D in the economy. Culturally, we have a problem. I hope one could say that our business people in this country are smart enough to recognize that, and readjust and look ahead to not just quarterly profits, but to long term R&D, adjusting to that, and hopefully people on the factory floor are countenanced by people who are on a higher social scale.

Again, this works better in Japan. They are able to take our ingenuity and come up with a product and sell it fast. They are going to beat us no matter who is out in front in basic research.

Mr. O'CONNELL. When Ed Denison made his estimate of the 34 percent contribution of advances in knowledge to U.S. GNP growth, he defined technology to include "knowledge concerning the physical properties of things, and how to make, combine or use them in a physical sense." It also includes managerial knowledge, knowledge of business organization and management techniques, construed in the broadest sense.

Clearly, we have a lot to learn, and I think many of our companies are trying to do that right now.

Mr. FAWELL. So we get back to that subjective ability of two people who work and cooperate together. I suppose that's where we get to the word "love." That's what makes the world go around. We have concern about each other, and work together.

I have appreciated your testimony greatly.

Mr. HALL. I appreciate Mr. Brown sharing the chair. If I make mistakes by asking questions he has already covered, please stop me. Being from the southwest, from Texas, I am very interested in the superconducting supercollider. One of my questions would be directed to you four gentleman along that line.

The United States has signed a memorandum of understanding, an intergovernmental agreement with their international partners. What are the pros and cons of entering into a formal treaty, in lieu of such a memorandum or intergovernmental agreement, other

than just the ease with which you can do one, and the time consumption of the other? What do they mean? How effective is the memorandum of understanding or the intergovernmental agreement? Is that just a step in the direction of a treaty?

Mr. TRIVELPIECE. You may have the advantage. I am not sure any of us have read it yet.

Mr. HALL. We may all have the same advantage, including some one those who signed it.

If you don't have a comment on it, we will go on to something else.

Mr. TRIVELPIECE. I certainly had a hand in the activities related to the SSC, and I believe that the idea that it should be built solely on the basis of U.S. funds alone, or U.S. talent alone, would be a mistake. The degree to which that takes some kind of agreement in order to make that occur in a way that all the parties to the activity feel appropriately bound might be necessary. Certainly it should not be prohibitive. I think it should be permissive. We stand to benefit not simply by the financial contributions that other countries would make, but in fact by the talent contributions in terms of the research, design and building of the device itself.

Mr. HALL. Professor?

Mr. POLLACK. I am not familiar with the specific agreement you are referring to. But I was thinking as you made your point that the space station agreement, the negotiation on that, and the experience that Al mentioned earlier of the United States backing out of several agreements in the energy area in 1981 with Germany and then with Japan has led some people in Europe, when the stakes are high and their investment is high, to seek something of a treaty status with the United States. That would make it, in effect, more difficult for the United States to change its mind on an agreement that will require major investments on the other side which have will have no value unless the entire project went through.

Generally speaking, based on such knowledge as I have of relations between governments, I personally would go for less formality, and hope that the mutual interests that both sides have as individuals and as organizations, in pursuing an objective, would suffice to bring it to a happy conclusion.

Mr. HALL. The genuineness would be evidenced by the wet ink signature and putting money up.

Mr. POLLACK. Right, the commitment of money and people and resources, yes, indeed.

Mr. HALL. Well, I think Mr. Trivelpiece in his testimony—and I presume you gave the testimony that was prepared—you suggested that the State Department or some other agency play an active role in disseminating foreign science and technology information to the U.S private sector. Provide us with some idea as to how this would be accomplished. What are the practicalities of it?

Mr. TRIVELPIECE. As I mentioned, the United States science counselors overseas are quite frequently not working scientists. They are foreign service officers. The State Department's view is generally that it wants accredited diplomats in those posts overseas, not necessarily scientists. I understand the reasons for that. On the other hand, I am sure that they would not say that they want an

accredited diplomat instead of a military officer as the military attache to a foreign post.

By virtue of that, then, they don't get quite the same access into some of the science facilities and so on of other countries, because they lack the standard scientific credentials. Scientists can wander into places that quite frequently a diplomat might not necessarily be able to get into.

So accumulating that kind of information, what is the policy of that country, where is it going with science, and so on—I don't believe we get as good information from our posts overseas as the foreign posts in the United States get and send overseas. To the extent we could tweak that up a little bit and improve it, and try to enlarge the flow of scientists to other countries to serve as inposts in embassies overseas, that would work to our benefit.

Mr. HALL. Upgrade the portfolio from the standpoint of science?

Mr. TRIVELPIECE. There was an executive order a few years ago which spoke to doing this. The State Department has tried to change some of the definitions but I suspect the budget is preventing them from doing this. Perhaps there is some reluctance on the part of some posts overseas to want scientists there. I imagine that some ambassadors don't necessarily want a scientist on their staff. We are not always reliable.

Mr. HALL. Are you suggesting, and I probably would agree with you, that the more diplomatic training that they had gone through, and the less scientific ability that they have, that they may miss some ideas in the world of science because they don't recognize them, or don't recognize them enough to pursue them to pass them back to us?

Mr. TRIVELPIECE. A working scientist has a certain natural curiosity about what is going on, not only in their own field, but in other fields. To the extent they would be a member of an overseas post, I think they would naturally pursue that.

That would then provide a better channel, or one additional channel for getting information back. The Office of Naval Research, for instance, has an office in London. It is a storehouse of information. The individuals who work there are scientists, they gather information, they provide it back, many people read it. I read it for quite a few years. It is a big storehouse.

Also, just the routine process of information gathering by scientists attending international conferences, as I mentioned earlier, to the extent we restrict that I think we actually handicap ourselves on a national basis.

Mr. HALL. Gentlemen, we really appreciate your testimony. All this testimony will be very helpful in reviewing Title V legislation, and we will continue the review on April 26 with Administration witnesses. I think it will be interesting to read your testimony and then to hear theirs.

This Committee and the Foreign Affairs Committee will review and consider to see if we think some legislative changes are in order. We are very grateful to you for the time you put in, not only giving your testimony, but in preparing it, and making time in your very busy schedule to come to the Hill.

Don't gauge the degree of appreciation of your services by the number of members that were here, because we are probably in the

most trying time we have been in the last five years. I have been in and out of about 15 meetings since I left here and came back. We are doing Clean Air, the budget, I am not sure what is taking place. Everybody is really working.

I left here about 1:00 o'clock this morning. So you are getting your dollars worth this time out of your legislators. The fact that you see scattered around here young bright minds and faces that represent the other members, they have soaked up what you have said, and your testimony does go into the record. They will all review it, and your visit here has been very worthwhile, and very much appreciated, not only by me and this Subcommittee, but by Congress and the people that you represent.

I thank all of you for your time.

[Whereupon, at 3:49 p.m., the hearing was adjourned.]

INTERNATIONAL SCIENCE AND TECHNOLOGY AND FOREIGN POLICY

THURSDAY, APRIL 26, 1990

U.S. HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
SUBCOMMITTEE ON INTERNATIONAL SCIENTIFIC COOPERATION,
Washington, D.C.

The subcommittee met, pursuant to notice, at 9:44 a.m. in room 2325, Rayburn House Office Building, Hon. Ralph M. Hall [chairman of the subcommittee] presiding.

Mr. HALL. The Subcommittee on International Scientific Cooperation will come to order. I am very pleased to convene the second of two hearings on an important and multi-faceted topic, the relationships of science and technology to U.S. foreign policy.

On April 4th, we began our review of this complex set of issues with several representatives from the private sector. Today, we will hear testimony from four very distinguished witnesses representing various agencies of the Administration.

We are grateful to you for your appearance here and for the backup work that you've put in in order to be in position to offer yourselves to this committee and to this Congress.

Twelve years ago, the Congress enacted Title V of Public Law 95-426, a provision designed to elevate science and technology both within the State Department and as an element of U.S. foreign policy. In 1978, the common view was that U.S. science and technology were so desirable and so preeminent that they could be offered around the world as diplomatic bargaining chips.

We can all readily agree that the world and the place of the U.S. in the world is changing, has changed, and will change. Witnesses who have spoken to this committee have offered differing views, although not necessarily mutually exclusive views, of what to do about some of the science and technology challenges facing the United States.

One witness asserted that since the universities and multi-national businesses are operating with less regard for national boundaries, governments, too, should predicate their science and technology relationships on a mutuality of interests and benefits that has not often been evidenced in the past. We have also heard about the need to continue to strive for a two-way street in technology transfer.

I know that efforts are currently underway in these agencies represented here today to do just that, and we are anxiously awaiting your recommendations and suggestions.

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One witness suggested that new "legislation should authorize the Department of Commerce to measure international technology flows in and out of the United States and cooperate with agreeing partners to construct appropriate data bases." One of our distinguished speakers on April 4th asserted that the time has come for global prioritization of big science initiatives and worldwide sharing of new basic knowledge which could benefit, for example, the environment or the commercial sector at large. This witness spoke of the need for an informal mechanism to encourage nations to take turns over a period of decades in underwriting basic science projects of global consequence.

The committee today hopes to hear some very constructive suggestions on how to increase the flow of U.S. scientists abroad to match the flow of foreigners who reside on U.S. soil to work and study to the ultimate technological benefit of their nations, and certainly, hopefully, of ours.

Finally, there is a matter of the Title V report itself, the 1990 version of which is being reviewed for final publication by our partners on the Foreign Affairs Committee. The Title V report has the potential to be a comprehensive compendium of agreements, relationships, and resources for international science and technology, yet it can be even more than that. We know that it can be and probably should be.

The Title V report could be a tool for planning and prioritizing U.S. science and technology issues, and we await your advice and guidance on that.

Our country needs firm direction in its science and technology policy and I turn to our very distinguished panel and ask you now: how are we doing? I guess you will be telling us in a little bit. Is this Administration developing the guideposts that will permit the U.S. to internationalize and manage a dazzling array of multi-billion dollar science and technology products and issues facing us during the decade of the 1990s?

Nations around the globe look to the U.S. for leadership. The key question before us is how we, the Congress, can help focus the debate so that the U.S. takes its rightful place on the international scientific team, the team now assembling across the globe to confront the challenges of this century and of the next.

I now offer the floor to my esteemed colleagues for any opening remarks. I turn first to Ron Packard, the ranking minority member of this subcommittee, who is an outstanding leader of the this committee.

Congressman Packard, we will recognize you at this time.

Mr. PACKARD. Thank you, Mr. Chairman. I have three pages of a formal statement that I would like entered for the record and then I will just comment.

Mr. HALL. Without objection, it will be admitted.

Mr. PACKARD. I think that not only this country but the globe itself is at a pivotal crossroads in terms of technology exchange with all the changes that have taken place in countries that we heretofore have been very sensitive about giving access to our technology or receiving technology from them has been very limited in the past several decades. All of a sudden we find ourselves now at a point where the whole globe has opened up to us. We have access

to their scientists and I am sure that their scientists are very anxious to exchange with our scientists both information and dialogue.

I think that we are now at a point in our history and the globe's history where we can and ought to establish policies that will be mutually beneficial with countries that heretofore we have not been able to have such an interrelationship with. I think that we are in a unique time and I hope that we can establish policies that will explore the new opportunities that we have.

I was just in Eastern European countries earlier this year and spoke with some of their scientists and business people. I could not believe how strong the craving for interchange was. All of a sudden that opportunity is here. They recognize it; we recognize it. It would be a tragedy in my judgment if we did not establish national policy that would enhance international relationships much beyond what we have been able to do in the past.

Furthermore, we are at a time in our own research where major science projects are going to be significantly inhibited and hindered. The SSC, the Superconducting Supercollider, of course, is one. We will not get anywhere with Space Station Freedom if we do not have international cooperation. That can now be extended into other major projects, the human genome, and a variety of others that we can not afford to do on our own without international cooperation.

Thus, I think that we are going to have to expand our vision and our willingness to involve others. National security heretofore has been a major impediment, and perhaps a justifiable impediment, of those kinds of exchanges, but I think that that has lessened significantly and I think that it would be easy for us to overemphasize national security interests at this time in our science history at the expense of science interests. Hopefully, we will be able to look at the policies of the past and evaluate them with our witnesses and testimony today in terms of what we want to do in the future.

We have such great opportunity even in the Soviet Union, the Europe-1990 group, Eastern Europe, which I have mentioned already, and of course, new opportunities have emerged in Asia. In Latin America we have new opportunities and certainly the need there is obvious for an improvement of exchange.

I am very optimistic that we are on the threshold and at the crossroads of a whole new world in terms of scientific research, scientific exchange, and scientific cooperation on a global level. Of course, that is what this committee is all about.

I appreciate this hearing, Mr. Chairman. Hopefully, it will produce the kind of information that will help us to move toward a whole new policy for this country. Thank you.

[The prepared statement of Mr. Packard follows:]

OPENING STATEMENT BY HON. RON PACKARD (R-CA)
INTERNATIONAL SCIENCE AND TECHNOLOGY AND FOREIGN POLICY
APRIL 26, 1990

Thank you, Mr. Chairman.

These hearings on the relationship of science and technology to foreign policy deal with critical issues currently facing Congress and this Administration: major global changes politically and economically; mega-projects infeasible without international resources; and global environmental change which demands international cooperation.

For the past several decades, the United States has enjoyed science and technology leadership. During that period, the flow of information over national boundaries was virtually unchecked. U.S. science and technology agreements imposed minimum restrictions, except to protect national security interests.

However, as the Chairman mentioned, in the twelve years since Congress enacted Title V of P.L. 95-426, virtually every area of the world has experienced some sort of major political or economic upheaval. The world economy has become global and highly competitive. Information is the new critical commodity. It has created new industries, like computers, semiconductors and designed materials. And through computers it has also transformed research--the very means by which new information is discovered.

Thus, international S&T agreements, which involve the transfer of this critical knowledge, must reflect economic, national security, environmental and scientific needs. I commend this Administration for recent initiatives to tap into critical resources to more effectively formulate these multi-faceted agreements: increasing interagency cooperation through CISET (Committee on International Science, Engineering and Technology); and enhancing private sector input through PCAST (President's Council of Advisors on Science and Technology).

As a member of the global community, the United States must promote cooperative research to solve international problems such as global environmental change and diseases. Some big science projects, such as the Earth Observing System and the mapping of the human genome, might not be feasible without the use of international human and monetary resources.

The United States must continue to realize the benefits of global science and technology cooperation. Certainly, we must strive to maintain a leadership role in science and technology. Yet I believe the way to accomplish this is not to put up barriers in an attempt to keep technology in. We must recognize that the U.S. no longer has a monopoly on technology. Rather, the flow of information should now be two-way, and the U.S. government must negotiate to gain greater access, "equitable access," to foreign technology.

In 1988, the Foreign Relations Authorization Act was amended to address the new concerns of "equitable access" to foreign technology. For example, the U.S.-Japan Science and Technology Agreement signed in 1988 provides the U.S. with balanced access to Japanese technology. This is not protectionism; rather, it is smart and fair trading of the valuable commodity of knowledge.

I believe these hearings will provide Congress with much-needed direction in examining the effectiveness of existing U.S. science and technology policy. This enhanced understanding is invaluable to us as we make difficult decisions during the authorization process.

I look forward to hearing the views and suggestions of our distinguished witnesses today.

Mr. HALL. We thank the gentleman from California.

Mr. Sensenbrenner was here.

Mr. PACKARD. He had to leave.

Mr. HALL. Of course, if he has a prepared statement, we will have it inserted into the record.

We will turn at this time to our very distinguished panel and recognize on the panel Dr. John Boright, Acting Deputy Assistant Secretary for Science and Technology Affairs with the State Department. We certainly welcome you and recognize you at this time. If you would like, you can summarize and your entire statement will be put into the record.

All four of you, of course, are not unaccustomed to testimony such as this. You do know that your entire statement will be put into the record for all Members to see and all staffers will read them. You are not just talking to two Members; you are talking to the entire subcommittee, the committee, and the Congress. We do appreciate your time.

Dr. Boright?

STATEMENT OF DR. JOHN P. BORIGHT, ACTING DEPUTY ASSISTANT SECRETARY FOR SCIENCE AND TECHNOLOGY AFFAIRS, U.S. DEPARTMENT OF STATE

Mr. BORIGHT. Thank you, Mr. Chairman. I appreciate very much the opportunity to appear before you today to discuss this subject. I will try to compress and pick the highlights out of my testimony and be reasonably brief.

I will try to address in particular changes that have created opportunities and challenges for international science and technology cooperation. Second, at least in a few cases, I will show how we are trying to deal with those opportunities. Third, you specifically asked what we think about the current appropriateness of Public Law 95-426.

There are several major developments in the world science and technology picture that I would like to point out. First, issues of global scope have become increasingly numerous and pressing. These include climate change, of course, atmospheric processes and the ozone layer, human genome mapping, AIDS, threats to the world's biological diversity, and so on. Improved scientific understanding in every one of these cases is urgently needed in order to project the future and understand our policy options.

As a second general trend, and as already pointed out by both you and Mr. Packard, movements toward democratization could well lessen the impediments to cooperation. Governmental research establishments in the Soviet Union and several other countries which have been centrally administered are becoming more autonomous. Western funding systems based on peer review are being considered and adopted in several cases. I will return to the question of Eastern Europe a little later.

Third, an increasing share of the top science and technology is now done in countries other than our own. This can be seen in funding data, scientific literature, engineering applications, patents and so on. As an example, support of non-defense research and development as a percent of GNP in Japan and Germany is consider-

able higher, about 2.7 percent, than it is in the United States. We are at about 1.7 percent.

If recent trends continue in the financing of civilian research and development, and in the growth of the European community itself, then by about 1992, the countries of the European community will essentially reach parity with the United States in terms of overall investment in science and technology. Also there are new and very vigorous players in the international research and development scene. Korea intends to devote five percent of its GNP to research and development.

It is urgent that we ourselves do more to ensure that we have the skills and the foresight and the human resources to use those opportunities for access to science and technology in other countries. I hope we can return to that during the panel discussion.

Fourth, while our own budget resources are obviously limited, science and technology is becoming more expensive. Alone, we can not pursue the many exciting and productive research opportunities before us. What we see is a multiplication of opportunities. They are not linear. You do not solve one problem and get to another one. You solve one problem and open a whole field of opportunities. There is just more than we can possibly capitalize on alone.

In addition, the conduct of private sector research is becoming inherently international. Funding, collaboration, and exploitation in a specific project often involve nationals of many countries and activities in many countries. Industrial research is frequently performed in a country other than the location of the parent company. And of course, the large majority of international technology transfer takes place in the private sector.

We should also note that "American" scientific talent has a very large and growing component of immigrants. It becomes quite difficult to think very distinctly in terms of ourselves as different from the rest of the world. Our linkages are very extensive now.

Despite these changes, our goals have remained essentially the same because they are broad and valid goals. Briefly put, they include contribution to the economic prosperity of our citizens, to our national security, to common goals such as environmental and health quality, and to peaceful and constructive relations with other countries. They also include, I must add, the adventure of progress in our scientific understanding of the universe. I have to mention that in particular, with the Hubble Space Telescope up there, while we are all panting for the first results.

These goals are appropriately stated in Title V. As I will discuss a little later, the guidance on process, including coordination with other agencies, is also appropriate. Therefore, we do not recommend specific changes in Title V at this time.

Let me very briefly address some of the questions you put into your letter of invitation.

The changes referred to particulary in Eastern Europe are opening historic opportunities for cooperation in science and technology. Some of these newly democratized countries are scientifically sophisticated and they have much to offer in specific research expertise. They represent economic and market potentials which are certainly going to be dramatically greater in the future.

Science and technology relationships can show our friendship and support and can provide the basis for expanded industrial relationships. They provide us with an effective means of encouraging the further development of democratic and free market institutions and a merit based funding system.

We are trying to be as helpful as possible in supporting cooperative science and technology activities in a way which does not require extensive hard currency expenditures during their difficult economic adjustment. Let me interject a point that has been made in the past but that I think is important to remember.

The resources which American technical agencies put into cooperation essentially are entirely for the expenses of the American-side collaborators. Here, I am talking about arrangements which simply trade off the expenses where we pay for the expenses in the United States and the host country pays on the other side.

The dramatic rise of Japan as a technological power is a major development with which we have to deal. We have set out in our 1988 agreement with Japan several things, principally, the goal of a more balanced access and technology relationship. Second, we have set some specific efforts to meet that goal, and third, mechanisms with which to monitor our progress. You probably know that most of us at the table here are going to be consumed all next week with the annual exercise of that agreement.

Europe-1992, of course, is a shorthand for in fact a whole range of ways in which the European countries and other institutions act increasingly as a national unity. We are now assessing the impact of these developments on our own science and technology interests. It does seem clear that we will continue to value our bilateral relations with European countries and that we probably need to exert some special efforts to sustain those relations. We will also need to continue to closely monitor and cooperate as appropriate with the growing European Community's science and technology programs, looking particularly at the issues which we all will be talking about of mutual benefit and access.

Mr. Chairman, you have also asked about policies which might lead to burden sharing in big science and in particular whether the United States is missing opportunities. What we need to do, of course, is not easy. We need to have the vision to set priorities which extend decades into the future. We need to work with potential partners from the conceptual stage on and we need the consistency of resource commitment to implement over those time scales. This effort has to include in particular the scientific community, at the very beginning and all through, the private sector, the Executive Branch, and the Congress, as well as our international counterparts in a real partnership relationship.

While we do have some excellent experience, in particular the ocean drilling program of the National Science Foundation, and while we have some major and exciting projects either underway or starting to be discussed with our international partners, such as the space station and the SSC, we are, of course, looking for additional opportunities. We are in the process within the science and government communities of upgrading this effort overall, and I think you will hear more about that from Dr. Ratchford. The FCCSET committee in particular, the Federal Coordinating Council

on Science, Engineering and Technology, can certainly contribute to our scientific vision and priority setting.

As an example of potential cooperation, we are considering how best to structure and sustain a major international effort in the use of space systems to monitor global changes. This example illustrates a particular concern of mine. That is: we should not think of big science exclusively as big pieces of equipment. In this and several other cases, such as the human genome and biological diversity, the tasks of storing, retrieving, and using data themselves are truly big science. They are massive chores, and it is critically important that we have effective cooperation in the use of these resources.

With regard to the Title V report, we believe that we have made progress. Title V, as you know, gives the Department of State primary responsibility for coordination and oversight with respect to major international science and technology agreements and activities.

The Department's role has been formalized by the establishment of a policy coordinating committee of the National Security Council and working groups under that committee. This committee is charged with the resolution of interagency issues and differences in all of the areas of oceans, environmental, and scientific affairs. It is chaired by the Assistant Secretary of State of OES. Also, Ambassador Bartholomew, the Under Secretary of State for Security Assistance, Science and Technology will chair the International Committee of the Federal Coordinating Committee which I mentioned.

In its coordination and oversight role, the Department works on a daily basis with the full range of agencies which have substantive interests in our science and technology cooperation. In particular, we coordinate the U.S. Government position on agreements. Our negotiations, of course, aim to achieve an optimization of U.S. interests in accordance with executive orders and relevant legislation, such as Section 5171(a) of the Omnibus Trade Act. In particular, we are working together with other agencies, and I think, making good progress in developing streamlined guidelines to most effectively achieve intellectual property rights protection and advance our overall science and technology cooperative interests.

I have two charts if I may just briefly show them to you to give you some idea of the number, the geographic, and the subject distribution of our agreements and what has happened over the past 10-year period. I will be very brief on these, Mr. Chairman.

The first chart shows within a proportionate area of the two circles the numbers of agreements we had in 1979 and 1989 and, in the colored wedges of those pies, the geographical area of the country in question. The number has grown dramatically in the first place. In the second place, Europe was in the beginning and remains as a very major cooperation partner. We have both Eastern and Western Europe together there, so some of that is a fairly dramatic recent increase in numbers of agreements with Eastern Europe. The rest of it, I think you can see. The other major increase is in the area of Eastern Asia and the Pacific.

The second chart shows the changes in numbers of agreements by subject over that 10-year period. Now, it would take a while to explain some of the details there. In particular, the energy agree-

ments, which in fact are the tallest bar on the whole chart, count more completely project agreements than do some of the other areas. Absolute consistency is a little bit difficult, but what you see there is a dramatic increase across many different substantive areas of our international agreements.

Within the Department of State, planning and review of science and technology issues is carried out by my bureau, the Bureau of Oceans, Environment and Scientific Affairs, and of course, we allocate our resources in view of current urgency of activities, a good recent example being increased effort we have put into the international diplomatic activity related to global change.

The Department also actively seeks outside input to its policy and planning efforts. The OES Advisory Committee serves this purpose. Academic and industrial experts serve as members of joint boards for some of our agreements. Department officials seek input from the national academies. One specific measure which we are taking is more regular discussions on science and technology issues between Department officials and academy panels which include a broad wealth of industrial and academic expertise.

With regard to the adequacy of our resources for planning and more generally to fulfill our oversight role, it is, of course, a considerable challenge to accomplish such a broad mandate. We could, we think, do more with more, but we also recognize that resources are limited. Overall, we do believe that we are able to provide a reasonable level of implementation of the U.S. policy.

One particulary difficult situation that I must mention is the current situation resulting from Section 614 of the Department's 1990 Authorization Act, which in fact cut in half the budget that we thought we had available for some modest but very important programs with Eastern European countries.

The Title V report itself can be considered as a planning tool as well as an assessment mechanism. Like other reports addressing such a broad range of issues, it is certainly not perfect. Annual publication leads to limitations on timeliness and there are logistical considerations that limit completeness of detail. However, we do consider that the report and its data base are a unique resource for both policy oriented and technically oriented users.

The report has been constantly evolving since the beginning and will continue to do so. We have been in frequent contact with committee staff and other agencies have included what we believe are several very useful improvements in the 1989 report. We are hoping to do even better in the 1990 report.

Mr. Chairman, let me close by very personally thanking the committee for its interest and involvement in international science and technology issues over many years. It is important for those of us working on these issues in the State Department and other agencies to know that there is sustained and thoughtful attention.

I know, for example, as a science counselor myself, how useful the sessions that we have had between your committee and science counselors are to our people. For our part, we are committed to making every effort to achieve the aims set out in the Title V legislation which succinctly states the importance of international science and technology.

Thank you for this opportunity to speak. I realize I have only very briefly touched on many of the issues. I would be quite pleased to try to answer any questions.

[The prepared statement of Mr. Boright follows:]

TESTIMONY OF

ACTING DEPUTY ASSISTANT SECRETARY OF STATE

for SCIENCE AND TECHNOLOGY AFFAIRS

JOHN BORIGHT

BEFORE THE

HOUSE COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY

APRIL 26, 1990

I appreciate the opportunity to appear before you today to discuss the role of bilateral and multilateral science and technology activities in U.S. foreign policy. This subject is a principal concern of the Bureau of Oceans and International Environmental and Scientific Affairs of the Department of State. It deserves sustained attention and care.

Mr. Chairman, I will address in my testimony: how changes in the world since the enactment of P.L. 95-426 have created opportunities and challenges for international science and technology field; how we are dealing with those opportunities and challenges; and what we think about the current appropriateness of the P.L. 95-426 framework. Throughout my

remarks, I will focus on the role of the Department of State.

Change has seemed to accelerate in many areas in the recent past, and I believe that the science and technology field is one of those in which change has been most dramatic.

I would like to outline several changes, each of which has contributed heavily to our opportunities and challenges in science, technology, and foreign policy.

First, issues of global scope--such as climate change, atmospheric processes and the ozone layer, human genome mapping, AIDS, and threats to the world's biological diversity--have become increasingly numerous and pressing. Improved scientific understanding of what is happening and of how to project future developments is desperately needed. At the same time global awareness of these issues has also increased rapidly. Consequently, both scientists and political leaders are far more ready than previously to engage in and support cooperative research activities. For example,

many of the advanced countries have proposals for international cooperation in the areas I just mentioned. The actual coordination and implementation of these ideas will require a major and long-term effort.

Second, movements toward democratization could well lessen many of the political, legal, or security-related impediments that have prevented scientists and engineers from associating and working with their colleagues in other countries. Governmental research establishments in the Soviet Union and several other countries have been centrally administered but, in some cases, are becoming more autonomous along Western lines. Universities may be playing a more important role. Further, Western funding systems based on peer review are being adopted in some cases. As a result of these developments, cooperative activities are becoming easier to initiate and more productive to carry out. The Department's contacts, at both the diplomatic and working levels will provide valuable help in selecting nations and scientists whose cooperation would be beneficial both scientifically and for our foreign policy objectives.

Third, an increasing share of the science and technology done in the world is done in countries other than our own. This can be seen in funding data, in scientific literature, and in practical engineering applications. For example, support of non-defense research and development as a percent of the GNP in Japan and Germany is considerably higher than in the US (about 2.7 percent and 1.8 percent respectively). If recent trends in the financing of civilian research and development continues, by 1992 the EC will essentially reach parity with the US at about 108 billion dollars. And there are new and vigorous players in the research and development scene. Korea, for example, intends to devote five percent of its GNP to research and development.

The growth in foreign research and development underscores the importance of reciprocal and equitable access to foreign scientific and technological opportunities. The Omnibus Trade Act of 1988 makes access to foreign labs a central part of US negotiations strategy, and we in the Department of State have taken steps to integrate access requirements in S&T cooperation. Also, much increased attention and effort has been devoted to providing for appropriate protection and

allocation of intellectual property rights, including those which might arise from science and technology cooperation.

We need to ensure that we have the skills and foresight to use those opportunities. We must not fall into the trap of assuming that S&T cooperation with the US benefits only other countries. When our own budget resources are increasingly strained, it is becoming more and more expensive to pursue the many exciting and potentially productive research opportunities before us. This is true in high energy physics, astronomy, materials, space exploration, and many other areas. More often and more urgently we are looking at the possibilities of cooperating with other countries to achieve together more than we could separately. The Department's diplomatic experience in multilateral organizations and instituions will become increasingly important to US S&T cooperation, especially with regard to long-term, multilateral projects.

Indeed, the conduct of research is becoming inherently international. Funding, collaboration, and exploitation in a specific project very often involve nationals of many countries, and activities in many countries.

Industrial research is frequently performed in a country other than the location of the parent company. When we add to this trend the fact that "American" scientific talent has a large and growing component of immigrants, it becomes more difficult to think in terms of ourselves as distinct from the rest of the world.

Despite these changes, our goals for international science and technology policy have remained essentially the same. These goals are outlined in many places, including in the legislation and in the several reports by the President pursuant to Title V: briefly put, they include contribution to the economic prosperity of our citizens, to our national security, to common global goals such as environmental and health quality, and to peaceful and constructive relations with other countries which are essential requirements for our own success. They also include the sheer adventure of progress in our scientific understanding of the universe in which we live.

These general goals are appropriately stated in Title V of P.L. 95-426. As I will discuss, the guidance on process, including coordination with other agencies, in Title V is also

appropriate. Therefore, we do not recommend specific legislative changes in Title V at this time. It is to the credit of the authors of this legislation that it remains applicable in current and foreseeable circumstances.

Let me briefly address some of the questions you posed in your letter of invitation before turning to the questions of process and the role of the State Department.

Eastern Europe and Latin America

The changes referred to in Eastern Europe and Latin America provide us with historic opportunities for cooperation in science and technology which we had not dared to hope for only a few years ago. Some of the newly democratized countries with which we are now establishing cooperative agreements are scientifically sophisticated, and have much to offer in specific research and development expertise. They represent economic and potential markets that will certainly be dramatically different in the future. Science and technology relationships with them can provide us with a very effective means of showing our friendship and support, and can provide

the basis for expanded industrial partnering and alliances. They provide us with an effective means of encouraging the further development of democratic and free-market institutions and a merit-based science funding system. At the same time, we are trying to be as helpful as possible in supporting cooperative science and technology activities in a way which does not require extensive hard-currency expenditures by them during their difficult economic adjustment.

Japan

The dramatic rise of Japan as a technological and economic power, and the movement toward European integration are major developments with which we must deal effectively. We have agreed with the Japanese: on the goals of a more balanced access and technology transfer relationship; on specific efforts to meet those goals; and on mechanisms with which to monitor our progress. The State Department has been providing essential staff support, as well as leading interagency preparations for our upcoming annual meetings with Japanese counterparts at the end of this month.

Europe-1992

Europe-1992, of course, is a shorthand for a broad range of formal and informal ways in which European countries or European industries and other institutions act increasingly as a national entity. We are less far advanced in our assessment of the impact of these developments on US science and technology interests than we are in assessment of our relationship with Japan. But we are working actively on it, in several ways. One forum for this examination is the interagency Committee on International Science, Engineering and Technology (CISET), within the FCCSET structure. It is clear that we will continue to value our bilateral relationships with European countries, and that we will need to consider special efforts to sustain these relations in a time of growing intra-European programs. We will also need to continue to closely monitor, communicate with, and cooperate as appropriate with the European Community science and technology programs, looking at issues such as mutual benefit and access.

"Big Science"

Mr. Chairman, you have also asked about policies which

might lead to more equitable burden sharing in "big science" projects, and whether the United States is missing opportunities to share the burden with other countries.

What the US Government needs to do to increase the effectiveness and balance of burden sharing is easy to state but difficult to implement:

-- we need to have the vision to set priorities which extend decades into the future;

-- we need to work with potential partners from the conceptual stage on; and

-- we need the consistency of resource commitment to implement over the long times involved.

This effort must include the scientific community, the private sector, the Executive Branch, and the Congress, as well as our international counterparts in a real partnership relationship. While we have some excellent experience (for example in the Ocean Drilling Program led by the National

Science Foundation), and while we have major and exciting projects (such as the Space Station and the superconducting super collider) now started or under discussion, we will look for additional opportunities. I believe we are in the process, within the scientific and government communities, of upgrading our efforts. You are hearing from Dr. Ratchford about the current activity in the FCCSET Committee, which can certainly contribute to our own scientific and policy concerns, and to our vision and priority setting. When appropriate, we use top level fora to emphasize international S&T cooperation.

As an example, we are considering how best to structure and sustain a major international effort including the use of space systems to monitor global changes. This example illustrates an important point: "big science" doesn't only mean big equipment. In several cases, such as global climate studies, the human and other genomes, investigating changes in the earth's biological diversity, and data on materials and chemical properties, the tasks of storing, retrieving, and using massive amounts of data are truly "big science" in themselves. It is critically important that we have effective cooperation in the use of these enormous data resources.

Title V Report

Let me now turn more specifically to the interagency process, to planning, review, and resources within the Department of State, and to the usefulness of the annual Title V report.

As noted, Title V gives the Department of State primary responsibility for coordination and oversight with respect to major international science and technology agreements and activities between the United States and foreign countries. The Department's role has been formalized by the establishment of the Policy Coordinating Committee of the National Security Council, and its working groups such as those dealing with Soviet and with Eastern European science and technology. This Committee is charged with review of issues and resolution of interagency differences in international oceans, environmental, and scientific affairs. It is chaired by the OES Assistant Secretary, and has representation of the appropriate agencies.

Also, Ambassador Bartholomew, the Under Secretary of State for Security Assistance, Science, and Technology, will chair

the International Committee (CISET) of FCCSET, which I have mentioned earlier.

In its coordination and oversight role, the Department works on a daily (or hourly) basis with the many technical agencies, with OSTP, OMB, and NSC staff, and with the full range of agencies (such as the Department of Commerce, Department of Defense, and the US Trade Representative) which have substantive interests in our science and technology relationships with other countries.

As part of its primary responsibility, the Department coordinates US Government positions in negotiations. Views of all interested agencies are sought and consensus reached, negotiation is formally authorized, and negotiating teams with appropriate expertise and interagency representation are put together. Negotiation aims to achieve an optimization of US interests in accordance with Executive Orders (such as 12591) and relevant legislation (such as Section 5171 (A) of the Omnibus Trade Act which relates to protection of Intellectual Property Rights (IPR) and to achieving equitable access). In that connection, State has worked in the interagency process to

develop guidelines to most effectively achieve intellectual property rights protection and advance our overall science and technology cooperative interests.

Within the Department of State, planning and review of science and technology issues are carried out in a variety of ways. The Bureau for Oceans and International Environmental and Scientific Affairs (OES) was established by Congress with the specific responsibility for such functions. In fulfilling these functions, the OES Bureau has a recently established policy, planning, and support division. At the office level within OES, goals and objectives are prepared. These are reviewed so we can allocate resources to priority areas. An example is the increased international activity related to global climate change. We are currently trying to project requirements for science and technology officers at US posts abroad, as a basis for resource planning. These officers provide invaluable support to all agencies of the US Government by serving as their ears and, often, representatives in other countries. Their role exemplifies the role of the Department in international S&T.

The Department also actively seeks outside input to its policy and planning efforts. An OES Advisory Committee was constituted for this purpose. Academic and industrial experts serve as members of joint boards that oversee some of our agreements. Department officials seek input from the National Academies. One specific measure which I am recommending within the Department, in fact, is a more regular system of discussions on science and technology issues between responsible State Department officials and Academy panels, which include a broad range of science and engineering expertise.

With regard to the adequacy of our resources for planning and more generally for fulfilling our oversight and coordination role, it is of course a considerable challenge to accomplish this broad mandate. Like all organizations, we feel we could do more with more. But we also recognize that US Government resources are limited. Overall, we believe we are able to provide a reasonable level of implementation of the policy set out by the President and by the Congress. One particularly difficult current situation has resulted from Section 614 of the Department's 1990 Appropriations Act, which

in effect cut in half the budget available for our Eastern European programs.

The Title V Report itself can be considered as a planning tool as well as an assessment mechanism. Like other periodic reports which attempt comprehensive coverage of broad subject areas, it is not perfect. Annual publication leads to limitations on timeliness, and there are logistical limitation on completeness of detail. That having been said, we consider the Title V Report and its database to be a unique and valuable resource which has come to serve both policy-oriented and technically-oriented users as the standard reference on our science and technology cooperation with foreign countries and on the roles of our technical agencies in such cooperation. It highlights issues for review and describes--for our purposes as well as those of the Congress--how the Executive Branch is responding to the Title V legislation. The database has made possible the rapid preparation of reports and other documents for State and other users.

As to the future evolution of the Report, I should first note that it has been constantly evolving since its inception

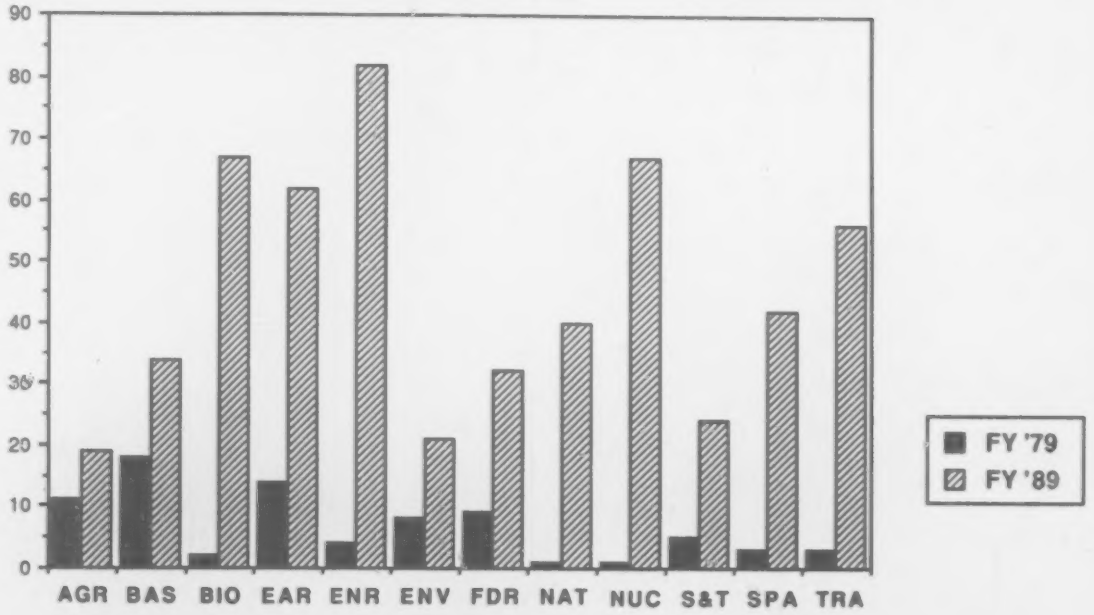
in response to congressional suggestions and those from State and other agencies. The 1989 Report contains many substantive and format changes designed to make it more responsive to congressional guidance and other user needs. We have been in frequent contact with committee staff and other agencies about further improvements which could be introduced in the 1990 Report. We will continue to work with other agencies to make further progress in the completeness of the Report.

I would like to close by thanking the Committee for its interest and involvement in international science and technology issues over many years. It is important for those working on these critical issues in the State Department and other agencies to know not only of the interest of your Committee but that there is sustained and thoughtful attention. I know, for example, as one of the participants in the past, that our annual sessions with US science counselors and officers with members of the committee is a valuable opportunity to inform and motivate our people. For our part, we are committed to make every effort to achieve the aims set out in the Title V legislation, which succinctly states the importance of international science and technology issues to

American diplomacy and to overall US interests.

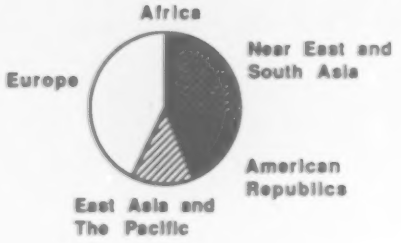
Thank you for this opportunity to express my views. I would be pleased to answer any questions you may have.

S&T AGREEMENTS BY SUBJECT

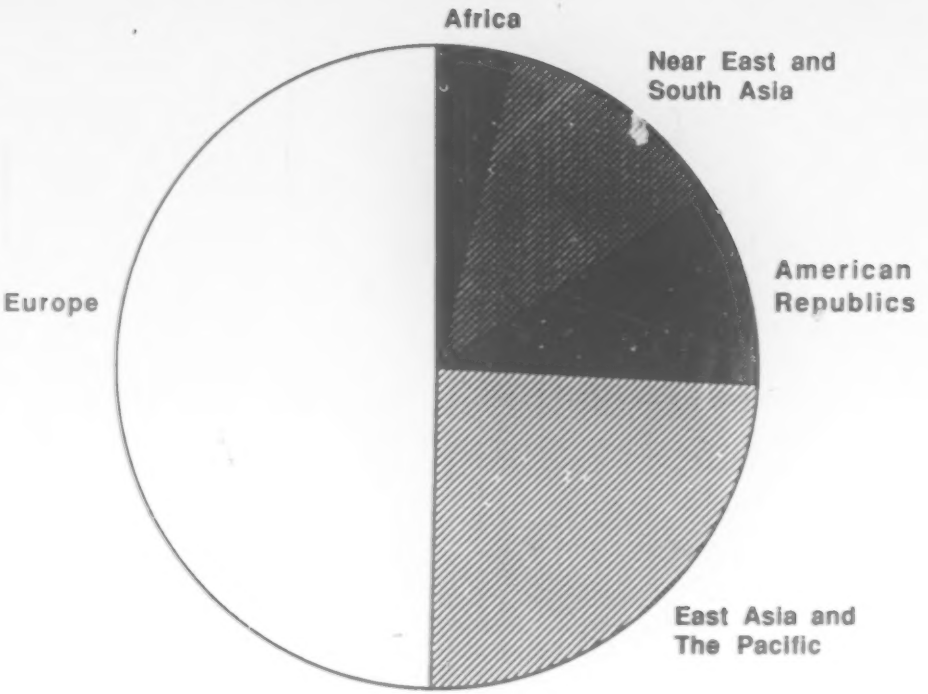


Key to Subjects:
AGR = Agriculture
BAS = Basic Sciences
BIO = Biomedical Sciences
EAR = Earth Sciences
ENR = Energy
ENV = Environment
FISH = Fisheries
FDR = Food and Drug Regulation
NAT = Natural Resources
NUC = Nuclear Safety
S & T = Science and Technology (Umbrella Agreements)
SPA = Space
TRA = Transportation

COMPARISON OF S&T AGREEMENTS BY REGION



FY '79 = 166



FY '89 = 594

Mr. HALL. Thank you, Dr. Boright. We will have some questions in a little bit, but we will wait until everyone has had an opportunity to summarize their testimonies.

Mr. HALL. We will now have Ms. Deborah L. Wince-Smith, Assistant Secretary for Technology Policy at the Department of Commerce.

We are glad to recognize you at this time, Ms. Wince- Smith.

STATEMENT OF DEBORAH L. WINCE-SMITH, ASSISTANT SECRETARY FOR TECHNOLOGY POLICY, U.S. DEPARTMENT OF COMMERCE

Ms. WINCE-SMITH. Thank you, Mr. Chairman and Members of the Subcommittee. It is a privilege to appear before you today to participate in this review of how scientific and technological developments influence our relations with other nations and the Commerce Department's role in these diverse activities.

The unbelievably rapid pace of worldwide technological development and political change is forcing everyone to rethink old truths about international science and technology relations, to do business in new ways, and to do business with new partners. No longer can anyone enjoy the luxury of the Not Invented Here Syndrome, a condition or state of mind that causes us to ignore technological developments made elsewhere.

The first fact we have to face is that technological competition will only intensify. Other nations have made very significant investments in their technological infrastructures and have demonstrated remarkable ability to translat successes in the laboratory into successes in the market place, which we know only too well as reflected in our negative trade figures. The number of competitors is increasing. Many developing countries are entering markets previously dominated by advanced industrial nations, and of course, we welcome that development.

The Department of Commerce approaches the review of international S&T issues from the perspective that if the United States is to remain technologically competitive, its fortunes are closely linked to S&T developments around the world. We have to pay close attention to the areas other nations are emphasizing and determine whether or not they allow us to have comparable reciprocal access to their activities. We have to ensure that we have effective mechanisms for identifying our industry's concerns as we enter into international S&T cooperative arrangements and negotiate agreements. This is particularly true for large scale R&D efforts.

I might mention in this context that in Japan, the Japanese Government has actively involved its industry from the very beginning in discussing the potential benefits of participating in such projects as the Superconducting Supercollider and more recently, Japanese industry has worked very closely with the MITI initiative in intelligent manufacturing systems. These have a tremendous potential for our competitive position in this key technology driver that is directly related to our trade position in the future.

We have to work hard to interest U.S. industry in participating in major government-supported projects, such as Japan's Key Tech-

nology Program and large scale efforts under MITI's leadership, which should lead to advancement in such technologies as new materials, biotechnology, new electronic devices, robotics, and high speed computing, as well as the information and telecommunications-related projects under the auspices of the European governments, such as ESPRIT, BRIGHT, RACE, and EUREKA.

We have to do a better job of encouraging researchers, particularly those from industry, to pursue research opportunities in these fields in foreign countries. We have to make sure that U.S. researchers in industry have adequate access to science and technology information developed abroad. We have to consider whether another nation's intellectual property system provides adequate protection for the intellectual property that may result from collaboration, including the most basic of collaboration, protections which provide necessary incentives for taking those risks so essential for ultimate commercialization, and of course, that the resulting rights are fairly allocated.

We have to make certain that international collaborative arrangements do not undermine other programs and domestic policies aimed at fostering U.S. competitiveness. In short, international science and technology arrangements and agreements must reflect the new reality of increasing worldwide technological cooperation. It can not be viewed as political good will gestures alone. The goal of adding to the world's storehouse of knowledge is very important, but all of these arrangements have to be looked at in this broader context that I have mentioned.

At Commerce, Secretary Mosbacher has recognized the importance of these arrangements to our technological competitiveness and has directed the Technology Administration to assume responsibility for coordinating the Department's position on pending agreements referred to us by the Department of State, including umbrella agreements that provide a comprehensive framework for bilateral S&T arrangements as well as specific agreements between Federal agencies and their foreign counterparts. Accordingly, when an agreement is referred to us, we look at it from several points and ask several questions.

To what extent are the conditions and promises in this agreement consistent with the U.S. Government's efforts to manage its own output of technology so that it returns to the taxpayers dividends in the form of new products, new processes, and new jobs? To what extent can we use these agreements as opportunities to increase U.S. access and participation in foreign government-supported projects with commercial potential or to obtain foreign technical information that our firms and industries can use, as Congress intended when it adopted the principle of symmetrical access in the 1988 Trade Act. To what extent can we be sure that resulting innovations are properly protected and that rights to them are fairly allocated?

Let me briefly mention the first of these points. Over the past decade, Congress and especially this Committee and the Executive Branch have worked together to fashion a series of laws and policies aimed at encouraging transfer to the private sector of technology developed as a result of the U.S. Government's more than $70 billion annual expenditure in R&D.

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Starting in 1980 with the Bayh-Dole Act, through 1986 with the enactment of the Federal Technology Transfer Act, through 1987 with the issuance of President Reagan's Executive Order No. 12591, we, working together, have put into place a comprehensive system aimed at fostering cooperative relationships between our Federal research institutes and U.S. industry. The heart of any system aimed at promoting the transfer to the private sector of technology developed by federal scientists and engineers or their contractors, such as universities or contractor-operated labs, is the ability of the cooperating parties to know in advance that they will be able to control and profit from any inventions they may make as a result of this research. That gives them the incentives to take the risks inherent in bringing a new technology to the market. These policies also make it easier for contractors and grantees, particularly universities, to attract private sector dollars.

Now we are seeing hundreds of new cooperative agreements between the government-operated laboratories, such as NIST or NIH, with private firms under the Federal Technology Transfer Act, which authorizes Federal agencies and the private sector to agree in advance on the ownership to any inventions resulting from the collaborative effort. Accordingly, Mr. Chairman, we recognize that these international S&T agreements must carefully consider the rights to resulting intellectual property that may be created as a result of bilateral efforts. They must be carefully worded so as not to undermine our domestic technology transfer programs, particularly in the very promising areas of advanced technologies. That is indeed the reason behind the Omnibus Trade and Competitiveness Act of 1988 in directing that proposed international S&T agreements be referred to Commerce for review for consistency with Federal technology management policies and programs.

The second issue I mention is the extent to which the agreements can be the basis for increasing our access and participation in foreign government-sponsored technology. Obviously, Japan is the country that springs to mind, given its enormous success at turning basic research laboratory results into success in the market place.

We at Commerce play a major role in implementing that agreement which identifies important areas for collaboration. It obligates the Japanese Government to work with us to increase the opportunities for U.S. researchers to work in Japanese facilities and to make information about Japanese technical developments available to us.

A goal of the agreement, as Dr. Boright mentioned, is to restore balance and reciprocity in our relationship with Japan. We see it as a model for future efforts. We need to identify those Japanese Government national programs in which it is in our interest to participate and in which we may be having difficulties or problems in participating. The problem, however, is that in some measure, due to difficulties associated with our researchers going to Japan compounded by concern about language and cultural barriers and the impact on their careers, we have not seen as much progress as we would like in American participation in these new opportunities.

Many of the issues covered in this agreement are those in which we are vitally involved in the Technology Administration. We chair the Task Force on Access to Scientific and Technical Information, and this is a natural role for us giving our Japanese Technical Literature Program responsibilities. We are making some progress in this area, but we still have problems, particulary in those dealing with the gray literature area, getting access to information in Japan that is not published in the open literature. Most of the significant Japanese work falls into this category. Another problem that we are addressing with the Government of Japan is the issue of their establishing a central reproduction rights organization because right now we can not obtain copyright protection or copyright release to many of the publications that we would like to translate. That is a very important issue.

Let me briefly mention the EC-92 issues, which Dr. Boright has covered in his testimony, and address whether or not we need to reassess our strategies. We know that there has been some concern that foreign researchers and U.S. firms in particular may be excluded in order to promote cooperation among EC member countries or that they may be given second class status as subcontractors.

That issue is being examined under the auspices of the Federal Coordinating Council's Committee on International Science and Engineering and a report will be issued shortly. In this context, we are pleased in Commerce that new collaborative arrangements are under way between our government-sponsored effort at SEMATECH and the European program of JESSI. We and the EC should strive to keep our S&T policies consistent with the 1988 OECD General Framework of Principles for International Cooperation in Science and Technology. We must protect the international mobility of scientists and, again, ensure reciprocal access to government-sponsored facilities.

The third area I mention is that we must look at these agreements to make certain that rights to resulting intellectual property are adequately protected and fairly allocated. We are spending over $70 billion per year on R&D and we have to make sure that if valuable property is developed that we have rights and that our partners' rights are respected.

The International Trade Commission estimated in a 1988 report that the United States may have lost some $40-60 billion from piracy and misuse of intellectual property of U.S. citizens. Clearly, we have to stem this tide. As we all know, this is one of the most important initiatives in the current round of the Uruguay trade talks.

The government has generally been successful in reaching accommodation with our foreign partners on intellectual property issues, but sometimes special measures have been necessary, most notably with India. In this case, the United States has unilaterally restricted its cooperation to those areas unlikely to result in the creation of intellectual property, although we make special accommodation for the national interest such as health or humanitarian concerns that justify cooperation. A special case by case review process has been established.

Though sometimes viewed as technical, issues such as the rights that are promised to other nations are very important to the success of the Federal Government's technology management initiatives.

Before concluding, I would like to briefly address the remaining issues addressed to me in the subcommittee's letter of invitation. One, you asked whether our Federal Register notice in 1988 elicited information from the private sector about their exclusion from foreign R&D projects. We have received little public information that we could verify, and I emphasize public information. We were not surprised because firms that want to do business in the global environment are not eager to publicize their concerns in this area. However, the important lesson for policy makers is that we can not take action based on anecdotes or vague assumptions.

You asked for my views on patent trends and whether they suggest that we are losing our technological edge. Naturally, we all sit up and take notice when we see the substantial increases in foreign patenting activity in the United States. We are concerned in Commerce. Indeed, Japan has steadily increased its share of U.S. patents, receiving 21 percent. West Germany receives 9 percent and France and the U.K. receive 3 percent. Four Japanese companies received more patents in 1988 in the U.S. than any other companies.

We have to remember that not all patents are equally valuable and ultimately their economic measure is determined by the commitment of industry to license these inventions and to turn their promise into new or improved goods in the market place. Of course, the classic example we refer to is the invention of Charles Ginsberg at Ampex back in the 1950s of video tape recording. He holds the patent on this invention and was just recently inducted into the Inventors Hall of Fame, but that key technology and the U.S. as the patent holder has never resulted in commercial benefit to our country because the license was sold early on to Japanese industry and we never exploited it.

We are still very strong in chemistry, biotechnology, petroleum, aerospace, and pharmaceuticals, and in the last 10 years, we have come on strong in molecular biology and microbiology, all areas where U.S. industry remains a world leader. We have to recognize that as other nations have built their technology infrastructure, some sharing of leadership in different technologies was to be expected, as reflected in patenting activity.

Japan receives a high percentage of patents in technically and commercially important areas such as dynamic information storage and retrieval, dynamic magnetic information storage, machine elements and mechanisms, photocopying, and other. The U.S. receives a low share in these areas. These findings appear to be consistent with the strengths and weaknesses of U.S. industry as indicated by our trade figures, but underscore the critical importance of linking the U.S. private sector and public sectors in working together to improve our commercial capability in these key technology areas.

In conclusion, Mr. Chairman, the internationalization of science and technology increases every day bringing new urgency to international science and technology cooperation and its agreements and arrangements. Cooperation is no longer an option; it is a neces-

sity. Many U.S. and foreign firms are entering into cross-border alliances to ensure that they will continue to have access to each other's cutting edge technology.

Most nations recognize the commercial value of their international collaborative S&T arrangements. Indeed, many of them have diplomats stationed abroad with strong science and technology and industry backgrounds, thus ensuring that their industrial technology interests are properly served. Executive Order No. 12591 directs the State Department to pursue a recruitment policy that encourages scientists and engineers from many sources to apply for such assignments, and the Commerce Department welcomes further progress in implementing that policy.

We at Commerce, where technological advancement is our mission, will continue to do our utmost to ensure that our international S&T arrangements serve the commercial interests of U.S. firms and industries as well as support the President's broader economic trade agenda and foreign policy goals.

Obviously, other interests also have to be reflected. The international community must address on an urgent basis issues that transcend national boundaries such as global change, biodiversity, food shortage, and world health problems. Again, these are all challenges in which our industry and commercial interests can benefit tremendously if they have an opportunity to participate from the beginning in the priority setting and execution of these programs.

The United States has set an example for the rest of the world to follow with regard to international science and technology cooperation and we continue to set the pace for creating policies and programs to guide and facilitate cooperation in a way that we hope benefits all parties.

Thank you, Mr. Chairman. I will be pleased to answer any questions that you or other Members may have.

[The prepared statement of Ms. Wince-Smith follows:]

STATEMENT OF

DEBORAH WINCE-SMITH

ASSISTANT SECRETARY OF COMMERCE FOR

TECHNOLOGY POLICY

BEFORE THE

SUBCOMMITTEE ON INTERNATIONAL SCIENTIFIC COOPERATION

COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

APRIL 26, 1990

Mr. Chairman and members of the subcommittee, it is a privilege to appear before you today to participate in this review of how scientific and technological developments influence our relations with other nations and the Commerce Department's role in reviewing international science and technology agreements.

The unbelievably rapid pace of worldwide technological development and political change is forcing everybody to rethink old truths about international S&T relations, to do business in new ways, and to do business with new partners. The private sector is learning how to cope with these new realities, and so are we in government. No longer can anyone enjoy the luxury of the Not Invented Here Syndrome, a condition or state of mind that causes us to ignore technological developments made elsewhere.

The first fact we have to face is that technological competition will only intensify. Other nations have made very significant investments in their technological infrastructures and have demonstrated remarkable ability to translate successes in the laboratory into successes in the marketplace. And the number of competitors is increasing as well. Many developing countries are entering markets previously dominated by advanced industrial nations.

Accordingly, the Department of Commerce approaches the review of international S&T issues from the perspective that if the United States is to remain technologically competitive, its fortunes are

closely linked to S&T developments around the world:

- We have to pay close attention to the areas other nations are emphasizing and to whether or not they allow us to have access to their activities.

- We have to ensure that we have effective mechanisms for identifying industry's concerns as we pursue our international S&T negotiations.

- We have to work hard to interest U.S. industry in participating in major, government-supported projects, such as Japan's Key Technology Program and Large-Scale Projects which should lead to advancement in such technologies as new materials, biotechnology, new electronic devices, robotics and high speed computing, as well as information and telecommunications-related projects which European Governments are supporting under the auspices of ESPRIT, BRIGHT, RACE, and EUREKA.

- We have to do a better job of encouraging researchers, particularly those from industry, to pursue research opportunities in promising fields in foreign countries.

- We have to make sure U.S. researchers and industry have adequate access to scientific and technological information

developed abroad.

- We have to consider whether another nation's intellectual property system provides adequate protection for the intellectual property that may result from collaboration - protections which provide necessary incentives for taking the risks essential for its commercialization - and that resulting rights are fairly allocated.

- We have to make certain that international collaborative arrangements do not undermine other programs and policies aimed at fostering U.S. competitiveness.

In short, international S&T agreements have to reflect the new reality of increasing worldwide technological competition. They cannot be viewed as political good-will gestures alone. The goal of adding to the world's storehouse of knowledge is laudable, but the agreements have to be looked at as part of a bigger picture.

At Commerce, Secretary Mosbacher has recognized the importance of these arrangements to our technological competitiveness and has directed the Technology Administration to assume responsibility for coordinating the Department's position on pending agreements, referred to us by the Department of State, including umbrella agreements that provide a comprehensive framework for a bilateral

S&T arrangement as well as specific agreements between federal agencies and their foreign counterparts.

Accordingly, when an agreement is referred to us for review, we look at it from several angles and ask ourselves several questions. For example:

- To what extent are the conditions and promises in this agreement consistent with the U.S. Government's efforts to manage its own output of technology so that it returns to the taxpayers dividends in the form of new products, new processes and new jobs?

- To what extent can we use these agreements as opportunities to increase U.S. access to foreign government-supported projects with commercial potential or to obtain foreign technical information that our firms and industries can use, as Congress intended.

- To what extent can we be sure that resulting innovations are properly protected and that rights to them are fairly allocated?

I will start with the first of these - federal technology management issues, for which the Department of Commerce has special statutory oversight responsibilities. Over the past

decade Congress - especially this Committee - and the Executive Branch have worked together to fashion a series of laws and policies aimed at encouraging transfer to the private sector of technology developed as a result of the U.S. Government's more than $70 billion annual expenditure in R&D.

Starting in 1980 with the Bayh-Dole Act, through 1986 with the enactment of the Federal Technology Transfer Act, through 1987 with the issuance by President Reagan of Executive Order No. 12591, we have put in place a comprehensive system aimed at fostering cooperative relationships between federal research institutions and U.S. industry.

The heart of any system aimed at promoting the transfer to the private sector of technology developed by federal scientists and engineers or technology developed by federal contractors, such as universities or contractor-operated national laboratories, is the ability of the cooperating parties to know in advance that they will be able to control and profit from any inventions they may make as a result of this research. That gives them the incentives to take the risks inherent in bringing a new technology to the market.

These policies also make it easier for contractors and grantees - particularly universities - to attract private sector dollars in two ways: one is the possibility of interesting an investor in

developing a federally financed invention; the other is the ability to tell a firm that is thinking of sponsoring research in the same area that it need not be concerned that the federal government may claim an ownership interest in some resulting innovation. University administrators tell us that these factors contributed to the more than 70% increase in private sponsorship of university research during the first part of the 1980's.

Now we are seeing hundreds of new cooperative agreements between the government-operated laboratories, such as NIST or NIH, and private firms under the Federal Technology Transfer Act which authorizes federal agencies and the private sector to agree in advance on ownership to any inventions resulting from the collaborative effort.

Accordingly, Mr. Chairman, we recognize that these international agreements must carefully consider the rights to resulting intellectual property that may be created as a result of bilateral collaborative efforts. They must be carefully worded so as not to undermine our domestic technology transfer programs, particularly in those promising areas such as advanced materials, superconductivity, biotechnology, aerospace, telecommunications and pharmaceuticals.

That is the reason the Omnibus Trade and Competitiveness Act of 1988 directed that proposed international S&T agreements be

referred to us for review for consistency with federal technology management policies and programs. Commerce now has in place a general framework that specifies the allocation of intellectual property rights that is consistent with law and U.S. policy.

The second issue I mentioned is the extent to which the agreements can be the basis for increasing our access to foreign government-sponsored technology. Obviously, Japan is the country that springs to mind, given its enormous success at turning laboratory results into success in the marketplace. Indeed, your letter of invitation specifically noted the recent U.S.-Japan Science and Technology Agreement.

We at Commerce play a major role in implementing that Agreement which identifies important areas for collaboration. It obligates the Japanese Government to work with us to increase the opportunities for U.S. researchers, particularly those from industry, to work in Japanese facilities and to work with us to make information about Japanese technical developments available to us. Again, a key challenge is to involve our researchers from industry in GOJ-sponsored R&D projects performed in Japanese industrial and national laboratories.

A goal of the Agreement is to restore balance and reciprocity in S&T relationship with Japan. We see it as a model for future collaborative efforts, especially as it pertains to access. U.S.

researchers have had some success in entering Japanese laboratories for study and research. But we need to identify those Japanese Government-funded national research projects that are being carried out in private sector labs that are closed to U.S. researchers. The problem is in some measure due to the difficulty associated with U.S. researchers going to Japan, compounded by concern about language and cultural barriers and anxiety on their part that such participation may not be in the best interest of their careers.

Many of the issues covered by this Agreement - and future agreements based on it - are issues in which the Technology Administration is vitally involved. For example, we chair the Task Force on Access to Scientific and Technical Information under the Agreement. This is a natural role for us: Our Japanese Technical Literature Program, for example, was established for the express purpose of making information about Japanese technical developments available to U.S. firms.

Similarly, as your invitation noted, one of our constituent units, the National Technical Information Service, disseminates information gathered by U.S. scientists posted overseas about foreign information of potential value to the U.S. economy under the STRIDE Program. That stands for Science and Technology Reporting and Information Dissemination Enhancement. The program was established pursuant to Executive Order No. 12591. The

information NTIS collects is disseminated through its weekly "Foreign Technology Abstract Newsletter." The newsletter is widely respected among senior officers of small high-tech manufacturing or service firms as a way of monitoring new technology trends and finding out about new products.

I do not want to leave you with the impression that we are concerned only with Japan. Indeed, you asked me whether I thought EC 92 implied a need to reassess our S&T strategies. I know that there has been some concern that foreign researchers may be excluded in order to "promote cooperation" among EC member countries. That issue is being examined by a working group established under CISET (Committee on International Science, Engineering and Technology) auspices and a report should be issued shortly.

We and the EC should strive to keep our S&T policies and regulations consistent with the OECD General Framework of Principles for International Cooperation in S&T. In particular, we must protect the international mobility of scientists and ensure reciprocal access to major government supported or sponsored research and facilities. And let me briefly note that when I say "mobility," I mean a two-way street. We have profited handsomely from the openness of our research system in the U.S. and the many thousands of researchers who visit our labs and universities have been a source of help to us. But the flow of

traffic must be in two directions to ensure reciprocity and mutuality of benefits.

In sum, international agreements are an important part of our ongoing efforts to gain access to vitally important foreign R&D programs and technical information.

The third area I highlighted is that we must look at these agreements to make certain that rights to resulting intellectual property are adequately protected and fairly allocated. We are spending over $70 billion a year on our R&D infrastructure and we want to make sure that if valuable property is developed, we have equitable rights and that those rights are respected under the laws of our collaborating partner. The International Trade Commission has estimated that the U.S. may have lost some $40-60 billion from piracy and misuse of intellectual property of U.S. citizens and we need to stem this tide.

One of the key approaches of the U.S. Government is to construct the intellectual property clauses of these agreements to ensure that we retain ownership rights to potentially valuable innovations in subject matter that the other country will not protect.

The Government has generally been successful in reaching accommodation but sometimes special measures have been necessary,

most notably with respect to India. In this case the United States unilaterally restricted its cooperation to those areas unlikely to result in the creation of intellectual property, although we may make special accommodation where the national interest, such as immediate health or humanitarian concerns, justify cooperation. A special case-by-case review process has been established.

Though sometimes viewed as technical, issues such as the rights that are promised to other nations are very important to the success of the federal government's technology management initiatives, to developing concepts of fairness that underlie all aspects of a bilateral S&T relationships, and to the U.S. goal of fostering increased worldwide respect for intellectual property rights.

Before concluding, I should like to address the remaining issues addressed to me in the Subcommittee's letter of invitation.

One, you asked whether our Federal Register notice in 1988 elicited information from the private sector about their exclusion from foreign R&D projects. We have received little public information that we could verify. We were not really surprised. Firms that want to do business in foreign markets have to be cautious. The important lesson for policymakers is don't take action based on anecdotes or vague assumptions.

Rather, our energies should be directed toward identifying the foreign resources we wish to tap and negotiating with the foreign government for access to them.

Finally, you asked for my views on patent trends and whether they suggest we are losing our technological edge. Naturally we all sit up and take notice when we see the substantial increases in foreign patenting activity in the U.S. Of course I'm concerned. Four Japanese companies received more patents in 1989 in the U.S. than any other companies.

But we do have to remember that not all patents are equally valuable. We are still very strong in chemistry, biotechnology, petroleum, aerospace and pharmaceuticals and, in the last ten years, we have come on strong in molecular biology and microbiology - all areas where U.S. industry remains a world leader. And we should also recognize that as other nations have built their technology infrastructures, some sharing of leadership in different technologies was to be expected.

We have to be very careful in interpreting these developments.

In conclusion, Mr. Chairman, the internationalization of science and technology increases every day, bringing new urgency to international science and technology cooperation and its arrangements and agreements. Cooperation is no longer an option;

it is a necessity. Indeed, many U.S. and foreign firms are entering into cross-border alliances to ensure that they will continue to have access to each other's cutting edge technology.

Other nations recognize the commercial value of their international collaborative S&T arrangements. Indeed, many of them have diplomats stationed abroad with appropriate science and technology backgrounds, thus ensuring that their industrial technology interests are properly served. Executive Order No. 12591 directs the State Department to pursue a recruitment policy that encourages scientists and engineers from many sources to apply for such assignments.

We at Commerce, where technological advancement per se is our mission, will continue to do our utmost to ensure that these arrangements serve the commercial interests of U.S. firms and industries as well.

Obviously, other interests also have to be reflected through these arrangements. The international community must address issues that transcend national boundaries, such as global change, biodiversity, food shortage, and world health problems.

The U.S. has set an example for the rest of the world to follow with regard to international science and technology cooperation and we continue to set the pace for creating policies and

programs to guide and facilitate cooperation in a way that benefits all parties.

Thank you, Mr. Chairman. I will be pleased to answer your questions.

Mr. HALL. Thank you for your fine testimony and we will have some questions in a little while.

Mr. HALL. We will now recognize Dr. Ratchford, of the Office of Science and Technology Policy, the Executive Office of the President. His is not an unfamiliar name or face to this committee or to this Congress.

Dr. Ratchford, welcome.

STATEMENT OF DR. J. THOMAS RATCHFORD, ASSOCIATE DIRECTOR FOR POLICY AND INTERNATIONAL AFFAIRS, OFFICE OF SCIENCE AND TECHNOLOGY POLICY, EXECUTIVE OFFICE OF THE PRESIDENT

Mr. RATCHFORD. Thank you very much, Mr. Chairman and Members of the Subcommittee. I appreciate this opportunity to testify on the effectiveness of Title V of Public Law 95-426 and the linkages between foreign policy and science and technology. Given the rapid pace of change in both foreign policy and in science and technology, reviewing the effectiveness of this decade-old law in the light of new global realities is indeed appropriate.

The global realities of 12 years ago when Public Law 95- 426 became law were very different from those we face today. In 1978, East-West tensions were much greater. We feared the oil cartel. The U.S. stood first among all the nations in the output of scientific knowledge and in technological innovation. This has changed.

There is a strong resurgence of democracy around the world. Japanese economic and technological successes pose new challenges for the U.S. Economic integration in Western Europe is creating an economic superpower. Global environmental change transcends national boundaries, challenging us to reevaluate our traditional approaches for addressing scientific and economic issues.

Further, we are moving into an information age in which knowledge will be a key determinate of national strength and international economic competitiveness. Science and technology have always been the most truly international of all human activities and will continue to be important foreign policy tools. The challenge we face is to find better ways of incorporating science and technology into our overall strategy for dealing with these new global realities.

Let me briefly note some of these challenges. First is environmental change on a global scale. A second critical challenge is the role of science and technology in economic growth. A third and perhaps our greatest opportunity and challenge in the basic sciences arena is how we manage international cooperation for the growing number of megaprojects which by their very nature are at the cutting edge of new scientific knowledge. A fourth challenge which really underlies the first three is how we cope with and utilize the burgeoning growth and information technologies.

Competition and cooperation between institutions and nations are more pervasive today than ever before. Here, the trend is away from government-controlled international cooperation in science and technology. With this said, however, there are important roles for government.

One of the government's main responsibilities is to help create an environment conducive to voluntary market driven cooperation in science and technology. The Administration is continuing to work within existing structures to develop this kind of environment. The government also has a role in planning and executing activities in basic science and related advanced technology where market forces will not necessarily support them.

Science and technology agreements with foreign countries are a basic element of our overall scientific and technological relationships with other nations. The U.S. today has about 600 science and technology agreements, as you heard earlier. These agreement serve as a basis for bilateral and multilateral exchanges between our technical agencies and foreign parties. By and large, the exchanges are in the basic sciences.

Given the increasing concern about science and technology and economic competitiveness, however, we are creating mechanisms to ensure that technology transfer officers in each technical agency are aware of and review all international science and technology agreements. The 1988 U.S.-Japan S&T agreement was the first time the U.S. faced in a comprehensive way the issues of reciprocity, comparable access, and the adequate protection and equitable distribution of intellectual property rights.

The agreement has increased our awareness of state of the art programs and facilities in Japan, improved the flow of scientific and technological information, and defined more clearly the issues and, hopefully over time, the solutions to the lack of balance in the relationship between our two nations. The U.S.-Japan S&T agreement was the first one signed that included a full annex addressing effective protection and equitable allocation of intellectual property rights.

The Administration has proposed IPR language consistent with the executive order and the Omnibus Trade Act for all of its umbrella agreements up for renewal and with most of its agency to agency agreements. In some cases, the annex has been adopted and exchanges have continued unabated. In other cases, generally where the foreign country has deficiencies in intellectual property protection, cooperation between agencies and their foreign counterparts has been curtailed while the Administration negotiates the annex.

The Federal Coordinating Council's Committee on International Science and Technology, as has been noted, is now reviewing the IPR issue. This review will be completed very shortly and should address many of the concerns expressed by several countries with which negotiations on science and technology agreements have come to a halt.

While we shall continue to depend on science and technology agreements as a principal means to facilitate bilateral cooperation in science and technology, we are also exploring new tools for dealing with international cooperation in big science projects. On Monday of this week, in his speech before the National Academy of Sciences, the President announced that the Administration is exploring new ways to encourage international cooperation on big science projects. We look forward to working with the agencies, for-

eign governments, and this committee in carrying out this new challenge.

As I mentioned earlier, the issue of scientific and technical information is increasingly complex. We are hampered by the lack of standards and common formats in the way we store, communicate, search, and manipulate data. In addition, there are national security and economic competitiveness concerns as well as economic and human barriers to effectively managing. storing, and disseminating this data. We are currently looking for creative ways to address some of these issues.

Mr. Chairman, the Office of Science and Technology Policy has an important leadership role in the formulation of international science and technology policy. Dr. Bromley is completing a revitalization and reorganization of the Federal Coordinating Council for Science, Engineering and Technology, the FCCSET, which includes the Committee on International Science, Engineering and Technology, CISET.

In addition, the FCCSET will provide input to the White House Councils, the Domestic Policy Council and Economic Policy Council, on broad policy issues that nonetheless contain substantial elements of science and technology. This new arrangement, through a working group of the Domestic Policy Council and the Economic Policy Council, was also announced on Monday by President Bush at the Academy.

Dr. Bromley has asked, as noted earlier, Under Secretary of State for Security Assistance, Science and Technology, Reginald Bartholomew, to chair the CISET. Dr. Fred Bernthal, Deputy Director of the National Science Foundation and Dr. Phillip Schambra, Director of the Fogarty International Center at the NIH, will serve as vice-chairmen of that committee. I will act as the OSTP liaison member to the CISET and provide appropriate policy input.

One element that has been lacking in recent years is high level external advice to science and technology policy makers in the government. I would emphasize external. This is particularly true in the international sector. One way that I hope we can address this problem is by tapping the newly created President's Council of Advisors on Science and Technology, PCAST, which is meeting as we speak.

Now, just a word about the Title V report and then my conclusions. I would like to take this opportunity to comment on the Title V report submitted to the Congress each year by the President. We would like to improve future reports to make the document a more useful and worthwhile tool, not only to the Congress but also to policy makers within the Administration and to scholars and leaders in industry.

In that regard, the CISET will convene a subcommittee to look specifically at the Title V report to determine how it can in fact be improved. The work of that group will probably take a few months and changes in the 1990 report will be incremental. That is: attaining perfection, Mr. Chairman, may take a little while. I and my colleagues at the Department of State will, of course, keep you apprised of our progress.

In conclusion, Mr. Chairman, it is important to emphasize that international relationships in science and technology are changing.

This is true for the basic sciences and for advanced technology development. It encompasses activities both competitive and cooperative. These relationships now are increasingly guided by market forces.

The choices are made mostly by private individuals, universities, companies, and consortia, but governments need to provide an environment conducive for these relationships to flourish. We can do this in several ways.

First, the Administration will continue to seek elimination of barriers for U.S. researchers wishing to do research overseas. Secondly, the Administration will continue to support fair and strong intellectual property rights protection and allocation. Third, the U.S. Government will play a leadership role in exploring ways to deal consistently, coherently, and effectively with the megaprojects and the basic sciences, those located in the U.S. and abroad. By doing so, we will instill greater confidence in the U.S. as a reliable research partner and more efficiently utilize the scarce funding for these projects.

Finally, and perhaps the most difficult task for the U.S. Government, is that we aim to diminish the role of the bureaucracy in conducting international cooperative research and increase the responsibilities of leading researchers. We in government will be judged in large part by the extent to which we facilitate international cooperation in science and technology. That requires the participation of the very best researchers at all stages of the process.

Mr. Chairman, thank you for this opportunity to testify before this distinguished subcommittee. I am, of course, available for any questions.

[The prepared statement of Mr. Ratchford follows:]

STATEMENT

BY

J. THOMAS RATCHFORD

ASSOCIATE DIRECTOR FOR POLICY AND INTERNATIONAL AFFAIRS

OFFICE OF SCIENCE AND TECHNOLOGY POLICY

BEFORE THE

SUBCOMMITTEE ON INTERNATIONAL SCIENTIFIC COOPERATION

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

APRIL 26, 1990

Mr. Chairman, members of the subcommittee, thank you for this opportunity to testify on the effectiveness of Title V of PL 95-426 and the linkages between foreign policy and science and technology. Given the rapid pace of change in both foreign policy and science and technology, reviewing the effectiveness of this decade-old law in the light of new global realities is indeed appropriate.

New Global Realities

The forces of change at work in the world today are placing new challenges before existing institutions and are changing their practices and codes of conduct. The global realities of twelve years ago, when PL 95-426 became law, were very different from those we face today. In 1978, East-West tensions were much greater. The major challenge to U.S. economic strength emanated from the oil cartel. The United States stood first among the nations in the output of scientific knowledge and technological innovation.

This has changed. Today, as new centers of economic and political strengths develop, international issues no longer fall into simple East-West or North-South categories. A strong resurgence of democracy around the world is enabling countries to express their own national aspirations, breaking down cold war barriers. The Japanese economic and technological successes pose new challenges for the United States at the same time that economic integration in Western Europe is creating an economic superpower in that region on a par with the United States and Japan. New issues such as global environmental change transcend national boundaries, challenging us to reevaluate our traditional approaches for addressing scientific and economic issues.

Further, information is rapidly becoming one of the most important commodities in the world. We are moving into an information age in which knowledge will be a key determinant of national strength and international economic competitiveness. Finding ways to collect, control, and disseminate this crucial resource will be a growing challenge for government and industry.

Challenges and Opportunities for S&T in International Relations

Science and technology, whether funded directly by the government or by private industry or institutions, have always been the most truly international of all human activities, transcending national boundaries even when political differences restricted exchanges in other areas. Science and technology, therefore, have been and will continue to be important foreign policy tools. The challenge we face is to find better ways of incorporating science and technology into our overall strategy for dealing with these new global realities. At the same time, there are new opportunities in science and technology for international cooperation on a scale we have never before seen. I would like to give a few examples of the types of challenges and opportunities for the United States in international science and technology.

One of the most important challenges we face today is developing the knowledge base necessary to address global environmental change. The prospect of environmental change on a global scale is forcing nations to examine a wide range of polices in light of our scientific understanding of the earth system and our influence on that system.

We need to look beyond traditional bilateral exchanges as tough economic and technology transfer questions work their way into the equation.

A second critical challenge is the role of science and technology in economic growth. In recent years, our market share in some high technology areas has declined as foreign trading partners have improved their marketing, production, and technical capabilities. Some of our industries have been slow in adjusting to the new reality that the United States must compete in a global market place and new mechanisms need to be found that allow companies and the federal government to work together to better meet this competition--including the proper protection of intellectual property rights in all federally supported S&T agreements. For example, we are improving the process for transferring the results of government funded research to the private sector for potential commercial development.

A third, and perhaps our greatest opportunity and challenge in the basic sciences arena, is how we manage international cooperation for the growing number of megaprojects, which, by their very nature, are at the cutting edge of new scientific knowledge. The research resulting from these projects--such as the Superconducting Super Collider, the human genome project, Space Station Freedom, and global change research--is a global resource adding to the knowledge base of all countries. These megaprojects are, in the aggregate, more costly than any one country can fund on its own and at the same time fund its base of research by individual investigators. Consequently, it is not only desirable, but increasingly necessary, to find better ways to coordinate international cooperation in the planning and support of these projects, including the need for involvement of potential partners in the initial planning and design phase as well as management.

A fourth challenge, which really underlies the first three, is how we cope with and utilize the burgeoning growth in information and information technologies. More than ever, scientific and technical information is now a global resource--one that is essential to cope with the global challenges ahead. There are an estimated 80,000 S&T journals published around the world, and perhaps 10,000 key, front-line journals. Yet with emerging, broad-based communications networks, it is entirely possible to share this enormous volume of information--and the far larger volumes of graphic and numeric data--around the world. It is important to point out, however, that making data available is not as simple as we might wish. Finding solutions to technical, legal, mechanical, and human problems in the exchange of this information will be necessary before we can reap fully the benefits of sharing information and data at the international level.

International Science and Technology Cooperation

Competition and cooperation between institutions and nations are more pervasive today than ever before. Commercial market forces, in addition to national political strategies, shape the vast majority of institutional relationships that cross national borders. As Dr. Ralph Gomory noted in his recent testimony before this subcommittee, the trend away from government-controlled international cooperation in science and technology will become more pronounced over time.

With this said, however, there are important roles for government. One of the Government's main responsibilities is to help create an environment conducive to voluntary, market driven cooperation in science and technology. The Administration is continuing to work within existing structures to develop this kind of environment. The government also has a role in planning and executing activities in basic science and related advanced technology where market forces will not support them.

International Science and Technology Agreements: Our government supported international science and technology agreements with foreign countries are a basic element of our overall S&T relationships with other countries. The United States today has over 600 science and technology agreements with foreign governments or agencies. These agreements serve as a basis for bilateral and multilateral exchanges between our technical agencies and foreign parties. They typically are motivated by specific objectives and needs of the particular mission agency involved, and the activities are expected to provide technical benefits within the agency's overall funding priorities. By and large, the exchanges and joint research projects are in the basic sciences, but, increasingly, technical agencies are looking to international cooperative agreements as a way to improve technology transfer from foreign countries to the United States. Given the increasing concern about science and technology and economic competitiveness, we are creating mechanisms to ensure that technology transfer officers in each technical agency are aware of and review all international S&T agreements. In many agencies this is a new role for the technology transfer officers created by Executive Order 12591.

U.S.-Japan S&T Agreement: The negotiation and subsequent signing in 1988 of the U.S.-Japan S&T Agreement in science and technology was the first time that the United States faced in a comprehensive way the issues of reciprocity, comparable access, and the adequate protection and equitable distribution of intellectual property rights. The U.S.-Japan S&T Agreement serves as a useful starting point for the negotiation of other government-to-government agreements.

While the U.S.-Japan S&T Agreement has not yet resulted in a large flow of U.S. researchers to Japan for long-term stays, we are cooperating with Japanese to increase sponsorship for such stays. In fact, additional numbers of U.S. scientists and engineers are beginning to become attracted to long-term visits to Japan through agreements that NSF concluded in 1988 with a number of Japanese government agencies. To date, however, the imbalance in the relationship is basically unchanged. Nonetheless, the Agreement has increased our awareness of state-of-the-art programs and facilities in Japan, improved the flow of scientific and technological information, and defined more clearly the issues and--hopefully over time--the solutions to the lack of balance in the relationship. We are confident that the Agreement as negotiated provides an adequate framework for effectively addressing the bilateral science and technology issues facing our two countries.

Intellectual Property Rights in S&T Agreements: The U.S.-Japan S&T Agreement was the first agreement to be signed that included a full annex addressing effective protection and equitable allocation of intellectual property rights (IPR). Prior to that

time, agencies would deal with the issues created by the development or exchange of intellectual property in a myriad of ways--some more effective than others--in protecting U.S. industrial competitiveness concerns. The IPR annex to the U.S.-Japan Agreement, and subsequent annexes concluded with other countries, now form a solid base for concluding other agreements. In the case of countries that do not have intellectual property commensurate with that of Japan, however, other provisions may be necessary.

The Administration has proposed IPR language, consistent with Executive Order 12591 and the Omnibus Trade and Competitiveness Act of 1988, for all of its umbrella agreements up for renewal, and with most of its agency-to-agency agreements. In some cases, the annex has been adopted and exchanges have continued unabated. In other cases, generally where the foreign country had deficiencies in intellectual property protection, cooperation between agencies and their foreign counterparts has been curtailed while the Administration negotiates the annex.

After more than two years of experience with the IPR annex of the U.S.-Japan Agreement, OSTP, under the auspices of the Committee on International Science, Engineering, and Technology--which I shall describe in more detail later--initiated a review of the annex. This was done with an eye toward streamlining the document, providing more flexibility to the technical agencies responsible for implementing the agreements, and getting stalled negotiations back on track. This review will be completed shortly and should address many of the concerns expressed by several countries with which cooperation has come to a halt. We believe that the new annex and guidelines are consistent with the Trade Act and the Executive Order, and that they go a long way toward addressing concerns of other countries. I am hopeful that we will be able to conclude a number of the agreements in short order. This is good for science and technology, and it is also good for U.S. competitive interests.

Megaprojects: While we shall continue to depend on science and technology agreements as a principal means to facilitate bilateral cooperation in science and technology, we are also exploring new tools for dealing with international cooperation in big science projects. In the past, the U.S. Government has been accused of being a somewhat unreliable partner in a few cooperative science projects. Part of the reason for this is a difference in how we make policy in the United States as compared to some other nations. They are able to make commitments for a number of years into the future on large projects. In contrast, we reevaluate our funding and research budgets every year and allow for the possibility of changing priorities. To quote Dr. Alvin Trivelpiece from his recent testimony before this subcommittee, "If the United States expects to invite international collaboration in its projects, it must consistently uphold its part of the deal."

Dr. Gomory and Dr. Trivelpiece in their April 4 testimonies both pointed to the need for the U.S. Government to find a way to overcome national rivalries and pursue big science projects in such a way that costs and benefits are shared equitably. OSTP is now beginning a study of how to develop a framework that will allow improved coordination and planning, including equitable funding arrangements, for

international cooperation on the megaprojects. It is important not to underestimate the difficulty in developing a workable approach. The magnitude of funding involved, disparities in content, schedule, and budgeting requirements are a few of the factors that make this a challenging undertaking.

S&T Information: As I mentioned earlier, the issue of scientific and technical information is increasingly complex. If we are to gain the full return on the federal government's investment in research and development--domestic or international--we must meet the challenges of storing, managing, and disseminating S&T information far more effectively--and on a much larger scale--than we do today. But, doing so is exceedingly difficult. We are hampered by the lack of standards and common formats in the way we store, communicate, search, and manipulate data. In addition, there are national security and economic competitiveness concerns with the dispersal of vast amounts of data collected from various sources for a variety of users. Finally, there are economic and human barriers to effectively managing, storing, and disseminating vast amounts of data, some of it in different human and computer languages.

We are looking for creative ways to address some of these issues. For example, one solution may be specialized data centers around the world that are equipped to interact with and help many different users. No matter what the solution, it is clear that we are entering swiftly into a digitally-based, information age. How we cope with this challenge will determine how effectively we address such problems as global environmental change.

OSTP's Role

Dr. Bromley's elevation to the position of Assistant to the President ensures that science and technology advice are an important and integral part of decision making in the White House. He is now a full member of the Economic Policy Council, the Domestic Policy Council, and the National Space Council. He also works closely with the National Security Council. This means that when issues, international or domestic, come to the forefront, Dr. Bromley takes a close look at them from the science and technology perspective. In this way, we ensure that science and technology are a part of the equation relating to major foreign, economic and national security issues.

FCCSET: OSTP has an important leadership role in the formulation of international science and technology policy. While much of this has been done in an ad hoc fashion in the past, a more orderly approach is expected in the future. Dr. Bromley is completing a revitalization and reorganization of the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET), which includes the Committee on International Science, Engineering and Technology (CISET). Among other things, the FCCSET will provide input to the White House Councils, such as the Domestic Policy Council and the Economic Policy Council, on broad policy issues that nonetheless contain substantial elements of science and technology.

Dr. Bromley has asked Under Secretary of State for Security Assistance, Science and Technology, Reginald Bartholomew, to chair the CISET. Dr. Frederick Bornthal, Deputy Director of the National Science Foundation, and Dr. Philip Schambra, Director of the Fogarty International Center of the National Institutes of Health, will serve as Vice-Chairmen of the Committee. I will act as the OSTP liaison member on the CISET to provide policy input. We think that this arrangement--Department of State as chair and two technical agencies as vice-chairs, along with the OSTP role in science policy matters, and of course, full participation by trade and other concerned agencies--provides an ideal way to bring together science and technology with foreign policy.

There is, of course, an international aspect to almost all science and technology activities of the United States. To provide for thorough coordination of all such research in the federal government, Dr. Bromley will meet on a monthly basis with the FCCSET committee chairmen to discuss ongoing activities. In this way, Under Secretary Bartholomew and the vice-chairmen will have opportunities to provide CISET input to other FCCSET committees and vice versa.

The FCCSET itself has been elevated to a very senior level within the Administration, and we are confident that it will provide the necessary influence to ensure that science and technology are active ingredients of our foreign and domestic policy.

OSTP also participates in the National Security Council's Policy Coordinating Committee which is charged with resolving specific questions in the Science, Oceans, and Environment area which involve security and foreign policy issues.

PCAST: One element that has been lacking in recent years is high-level external advice to science and technology policy makers in government. This is particularly true in the international sector, where there are often competing interests and concerns. One way that I hope we can address this problem is by tapping the newly created President's Council of Advisors on Science and Technology (PCAST). This group, chaired by Dr. Bromley and directly reporting to the President, provides a vast array of knowledge and expertise from the private sector on which we can draw for specific advice.

Title V Report

I would like to take this opportunity to comment on the Title V Report submitted to Congress each year by the President. The current report responds to the charge included in the legislation, however, we would like to improve future reports to make the document a more useful and worthwhile tool, not only to the Congress but also to policy makers within the Administration and to scholars and leaders in industry.

In that regard, the CISET will convene a subcommittee to look specifically at the Title V report to determine how it can be improved. The work of that group will probably take a few months, and changes in the 1990 report will be incremental. I and my colleagues at the Department of State will of course keep you apprised of our deliberations on this matter.

Conclusion

In conclusion, Mr. Chairman, it is important to emphasize that international relationships in S&T are changing. This is true for the basic sciences and for advanced technology development; it encompasses activities both competitive and cooperative. These relationships now are increasingly guided by market forces. The choices are made mostly by private individuals, universities, companies, and consortia; but governments need to provide an environment conducive for these relationships to flourish.

Because of this changing landscape, government's role in directing international S&T cooperation is diminishing. As Dr. Gomory pointed out in his testimony, government-orchestrated exchanges will be much less important in the future. While this is indeed correct, there remains a special role for government in providing an environment that is conducive to the free flow of scientists, equipment, and ideas across national borders consistent with U.S. laws and regulations.

First, the Administration will continue to seek elimination of barriers for U.S. researchers wishing to do research overseas. We pride ourselves on an open research environment in the United States, and we ask nothing less for U.S. scientists and engineers seeking opportunities to study and work abroad.

Second, the Administration will continue to support strong and fair intellectual property rights protection and allocation. Our attempts to do so will be in consultation with industry and universities to ensure that what we strive for is consistent with their needs.

Third, the U.S. government must play a leadership role in exploring ways to deal consistently, coherently, and effectively with megaprojects in the basic sciences, both in the United States and abroad. By doing so, we will instill greater confidence in the United States as a reliable research partner and more efficiently utilize the scarce funding for these projects.

Finally, and perhaps the most difficult task for the U.S. government, we aim to diminish the role of the bureaucracy in conducting international cooperative research and increase the responsibilities of leading researchers. We in government will be judged in large part by the extent to which we facilitate international cooperation in science and technology, and that requires the participation of the very best researchers at all stages of the process.

Mr. Chairman, thank you for this opportunity to testify before this distinguished subcommittee. I am of course available for any questions at this time.

Mr. HALL. Dr. Ratchford, thank you. We might make a quick deal with you now. We won't ask you what the ETA is for that point of perfection if you don't ask the Congress the same question.

[Laughter.]

Mr. HALL. Dr. Richard Ries, Acting Director, Division of International Programs for NSF, we recognize you at this time.

STATEMENT OF DR. RICHARD RIES, ACTING DIRECTOR, DIVISION OF INTERNATIONAL PROGRAMS, NATIONAL SCIENCE FOUNDATION

Mr. RIES. Thank you, Mr. Chairman and Members of the Subcommittee. I would like to express my thanks for this opportunity to provide NSF input into the hearings on Title V. With your permission, I would like to submit my complete written statement for the record, as you indicated earlier.

Mr. HALL. Without objection, all four of the written statements will be put into the record.

Mr. RIES. Thank you. I will just highlight the major points now.

Effective and creative implementation of Title V depends at least in part on the creativity and the effectiveness of the actual scientific programs designed by the government's technical agencies. As you know, NSF provides support for cooperative research between U.S. scientists and engineers and their colleagues in many different countries.

NSF awards these cooperative research grants under the terms of a set of about 30 bilateral agreements that we have negotiated with foreign counterpart agencies under the guidance of the Department of State. I will describe some recent initiatives that have grown out of NSF's experience working within that network of bilateral agreements and programs.

These are initiatives that respond to the very important political, economic, and scientific changes in Europe, both East and West, changes in the Far East, and in Latin America. Let me turn first to Eastern Europe.

In Eastern Europe, several countries, notably Hungary, Czechoslovakia, and Poland, have research centers with traditions of scientific excellence. There are also some small first rate groups that have had contacts over the years with the U.S.

Within the last few years, NSF has developed bilateral relations with all major Eastern European countries except the German Democratic Republic. For example, our longstanding cooperative program with Hungary, going back to the mid- seventies, has been extremely productive from a scientific perspective.

As Eastern Europe engages in political decentralization, the accompanying liberalization is giving scientific institutions in Eastern Europe more autonomy. U.S. investigators are gaining better access to Eastern European research sites and the mobility of Eastern European scientists and engineers is clearly increasing.

Evidence of this mobility and change may be seen first hand in a visit to NSF last week by a Polish Government representative who informed us that NSF is going to serve as the model for the way Poland plans to revitalize its funding decision mechanisms. They will in fact be sending several of their staff to NSF this summer for

training purposes. Similarly, Soviet scientists are able to travel more freely than in the past and they, too, would like to establish a bottoms-up support system for individual investigator proposals.

In February, NSF arranged a special program for a group of Soviet science managers. About a dozen came to learn how NSF operates. Their goal is to develop a responsive system of financial support for Soviet scientists and engineers.

NSF is poised to take advantage of these scientific opportunities. Less than a year ago, the Foundation and the Department of State established an agreement with the Academy of Sciences of the Soviet Union to support cooperative projects proposed by U.S. investigators and their Soviet counterparts in seven basic research fields. The first meeting of the joint U.S.-U.S.S.R. Commission on Cooperation in Fields of Basic Research—that's the group that oversees this agreement—met last week for the first time. The U.S delegation was headed by our Science Advisor, Dr. Bromley. That meeting confirmed that a firm basis has been laid for cooperation.

Next, I would like to take a look at Western Europe. While it lacks the drama of the East's political liberalization, Western Europe's economic integration, referred to as Europe-1992, will definitely affect U.S. science and engineering. Scientific relations between the U.S. and Europe go back for more than a century. Today, that relationship is reflected in part by bilateral programs that NSF and other agencies have maintained with virtually all of the Western European countries.

Because of the quality of U.S. science and engineering and our longstanding relations at both governmental and nongovernmental levels, we believe that U.S. scientists and engineers will continue to be sought as participants and partners in cooperative projects in Europe after 1992. Officials of the European Community in Brussels are actively seeking areas in which joint projects can be established with NSF and with other Federal agencies.

We believe that U.S. investigators will continue to enjoy collaborative research opportunities in Europe. However, the terms of their participation may change as additional resources for research become available to European scientists. One significant change in our relationship may well be psychological. Increasingly, young Western and Eastern European investigators will think of the whole of Europe as an arena for their research.

Let's look for a moment at NSF programs with Japan. Our relationship with Japan, as has already been noted by earlier speakers, has been subjected to intense scrutiny. NSF continues to develop effective bilateral relations with Japan and has in fact had an office at the U.S. Embassy in Tokyo for almost 30 years.

Recently, we established a special set of initiatives aimed at encouraging more U.S. scientists and engineers to work for extended periods in Japanese laboratories. These initiatives, to which Japan makes a substantial financial contribution, provide opportunities for U.S. investigators to conduct research at Japanese university, government, and industrial laboratories. They also enable our scientists and engineers, including graduate students, to study the Japanese language.

As a result of these initiatives, the numbers of U.S. investigators going to Japan for long-term working visits is increasing. Prior to

1988 and the signing of the agreement between the U.S. and Japan, only a handful of U.S. investigators went to Japan each year for such research visits under government-sponsored programs. Between May, 1988 and the present, NSF has made awards to support over 100 investigators to spend extended periods in Japanese laboratories, but I am afraid that we still have a very long way to go to balance that relationship.

U.S. investigators seem to be doing quite well in Japan. A group of 94 who have had substantial experience there were surveyed by NSF recently about their experiences. None noted any major problems with access to the facilities that they required to conduct their research effectively.

Finally, there is the situation in Latin America. Democratization in Brazil, Argentina, and now Chile has made it easier for U.S. investigators to collaborate more freely with such groups. Unfortunately, however, economic conditions there remain a barrier to increased cooperation.

New democratic regimes have been forced to institute draconian economic measures that affect support for their science and technology. Nevertheless, there are several areas of scientific strength in these countries for which focused cooperation would be advantageous to the U.S. and also would help the indigenous research communities.

Latin American countries understand that research support is an important investment in their future. For example, President Carlos Salinas of Mexico has appointed the first scientific consultative council and presidential science advisor in Mexico's history. U.S. Government agencies and their Mexican counterparts are seeking to identify areas where enhanced cooperation between U.S. and Mexican investigators could lead to mutual benefit.

A joint NSF and NASA independent study of collaborative opportunities with Latin America was authorized by the committee in fiscal year 1989. That study documented the drastic decline in opportunities for students from Latin American countries to pursue advanced study in the United States.

The U.S. has much to gain by providing such opportunities for students from both Latin American and Eastern European countries to pursue advanced study here. Those who receive degrees and return home will definitely contribute to the development of their own countries and are likely to maintain lifelong bonds with their U.S. colleagues. Those who choose to remain here would clearly make contributions to our research efforts.

Eastern European and Latin American governments also have severe environmental problems in common and are acknowledging them and requesting international help. Enhanced cooperation with these groups may add new knowledge and may contribute significantly to the preservation of the global environment.

In conclusion, Mr. Chairman, 12 years ago when the U.S. Congress enacted Title V of Public Law 95-426, it recognized the desirability of linking science and technology closely to American diplomacy. The vitality of U.S. science and technology is partly due to the highly diffuse and decentralized nature of these enterprises.

The academic, the industrial, and the government components of our scientific and technical enterprises have different but closely

related motives. Thus, although six government agencies account for more than 90 percent of the Federal Government's budget for R&D, more than 20 agencies have some stake in this country's science and technology activities.

Under those circumstances, any attempt to focus science and technology resources on a specific foreign policy goal is a very daunting task. It is, however, a task worthy of our best efforts. Rather than trying to recast Title V, we need to work harder to fulfill its spirit.

On behalf of NSF, I would like to thank you for this opportunity to appear before you and to receive your renewed assurances that our efforts to make better use of science and technology in the service of U.S. foreign policy are indeed worthwhile and appreciated.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Ries follows:]

REMARKS OF DR. RICHARD RIES

ACTING DIRECTOR, DIVISION OF INTERNATIONAL PROGRAMS

NATIONAL SCIENCE FOUNDATION

HEARINGS ON TITLE V OF PUBLIC LAW 95-426

BEFORE THE SUBCOMMITTEE ON INTERNATIONAL SCIENTIFIC COOPERATION

OF THE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,

U.S. HOUSE OF REPRESENTATIVES

APRIL 26, 1990

Mr. Chairman, Members of the Committee.

Title V of Public Law 95-426, enacted in October 1978, declares that, "United States foreign policy should be continually reviewed by the executive and legislative branches of Government to insure appropriate and timely application of science and technology to the conduct of United States foreign policy." Today's hearings provide a welcome opportunity for such a review.

By enacting Title V, the Congress formally recognized that worldwide advances in science and technology can have significant influences on U.S. relations with other countries. Likewise, political changes, as well as changes in science and engineering capabilities abroad, offer new challenges and opportunities for the conduct of our own science and engineering activities. The law therefore requires that due consideration

be given to scientific and technological factors in the formulation and conduct of U.S. foreign policy. A key provision intended to implement that requirement directs the U.S. Government's technical agencies to inform and consult in advance with the Secretary of State and other relevant agencies with respect " . . to any major science and technology-related actions they plan with respect to foreign governments or international organizations.

A stated goal of today's hearings is to assess whether Title V is being implemented " . . effectively and creatively by the Federal Government." Effective and creative implementation depends in large measure on the extent to which the programs designed by the Government's technical agencies are themselves effective and creative. I propose to describe several initiatives that the National Science Foundation (NSF) is taking to respond to new challenges for U.S. science and engineering brought about by important political, economic, and scientific changes occurring in Europe, the Far East, and Latin America. These initiatives are based on the knowledge and experience that NSF has acquired over many years in working closely with foreign counterpart organizations throughout the world, in cooperation with the Department of State, particularly its Bureau of Oceans, Environmental, and Scientific Affairs (OES) and the Office of Science and Technology Policy (OSTP). The extent to which these NSF initiatives comprise an effective response to the challenge of linking science and technology effectively with U.S. foreign policy provides one measure of the overall effectiveness with which Title V is being implemented.

NSF's primary mission, in addition to supporting science education at all levels, is to award grants for the research activities of U.S. scientists and engineers. Approximately 20 percent of those grants have at least some international implications. Most often, they provide support to permit U.S. investigators to travel abroad, frequently to attend international conferences, sometimes to conduct research at a foreign centers. Some of those grants, particularly in fields such as oceanography, atmospheric science, or environmental biology, support substantial research activities in foreign countries, frequently in collaboration with foreign colleagues.

In addition to such grants with foreign implications, awarded primarily by our disciplinary divisions, NSF provides explicit support for cooperative research between U.S. scientists and engineers and their colleagues in a large number of countries, as well as support for groups of investigators in specific fields to meet and plan long-term joint research programs. Many cooperative research grants are awarded under the terms of a set of bilateral agreements that NSF has negotiated with foreign counterpart agencies in consultation with, and under the guidance of, the Department of State and other relevant agencies. The initiatives I propose to describe have grown out of NSF's long experience in working with that network of bilateral agreements and programs.

No doubt the most dramatic series of political events to have occurred during the past year has been the liberalization of Eastern Europe. Political liberalization does, in fact, offer expanded opportunities for mutually beneficial cooperation between U.S. and Eastern European investigators. The mobility of Eastern European scientists and engineers is certain to increase, and U.S. investigators can gain more ready access to Eastern European research sites. In addition, political decentralization that is accompanying liberalization is resulting in considerably more autonomy for scientific institutions in these countries. Although the emergence of new scientific institutions is bound to be confusing in the short run, it should ultimately lead to an enriched research environment.

Several Eastern European countries, notably Hungary, Czechoslovakia, and Poland, have research centers with long traditions of excellence in science and engineering, as well as first rate groups that, although often relatively small, have maintained contacts over the years with their U.S. counterparts. For example, Poland excels in mathematics, astronomy, theoretical physics and materials research; Hungary in mathematics, physics, and life sciences; and Czechoslovakia in chemistry and materials research. The very changes that are enhancing scientific opportunities more broadly in Eastern Europe also suggest potentially rewarding lines for cooperative research. In a very real sense, Eastern Europe is a living laboratories of political and economic change. Thus there are unique and exciting opportunities for U.S. scholars in the social and economic sciences to collaborate on problems of common interest.

NSF has official bilateral relations with all major Eastern European countries, with the exception of the German Democratic Republic. The cooperative program with Hungary is longstanding and has been extremely productive. Our experiences with the others are more recent and mixed. However, we already see evidence that these contacts are paying off in the new atmosphere of political liberalization. Recently, a representative from Poland visited NSF and informed us that they regard NSF as a model for the way they should revitalize the mechanisms for making funding decisions about science in their country. In 1987, the State Department, along with NSF and other R&D agencies, revitalized a lapsed a Joint Fund with Poland that went into effect during FY 1989 and provides additional funds for cooperative research with that country. A Joint Fund with Hungary is scheduled to go into operation during FY 91. The operations of both programs is similar to that of a long-standing Joint Fund with Yugoslavia. However, in all candor it should be pointed out that the funding prospects for these programs are uncertain, suggesting one major problem area for the United States in international science and technology. I believe that Dr. Boright has more to say on that subject.

Political changes are having a particularly noteworthy effect on the conduct of science and engineering in the Soviet Union. Soviet scientists are able to travel more freely and express themselves much more openly than in the past. A goal of many of these scientists is to develop a system of financial support more responsive to the initiatives of individual scientists. In February, NSF arranged a special week-long program for a

group of Soviet science managers who came here to learn the details of NSF's operations. They too would like to establish a system for supporting "bottom-up," individual investigator proposals on a competitive basis as NSF does. Next month another group will be here to discuss the development of science and engineering indicators. Publication of standardized indicators by the Soviet Union will give us a much more detailed picture of the state of science and technology in that country and therefore a better basis for planning effective cooperative programs.

Within the country itself, a new Union of Soviet Scientists has been established on the basis of a Declaration of Scientific Rights that probably would have been seen as subversive five years ago. The President of the American Physical Society recently received a communication from the president of the newly formed Soviet Physical Society informing him of the society's existence, noting that no such society has existed since 1930, and asking for help in developing a coherent organization and set of programs. That new society is contemplating an English language journal which will be reproduced and distributed from London so that physicists throughout the world will be better able to keep abreast of the work of their Soviet colleagues. In the short run, organizational changes such as these may make cooperation with the Soviet Union, somewhat more difficult than it was under the former, highly centralized system. However, in the long run opportunities for cooperation are almost certain to broaden as U.S. investigators gain more or less routine access to Soviet scientists working at the grass roots level.

We are well poised to take advantage of the new scientific opportunities in the Soviet Union. Less than a year ago, the National Science Foundation, working with other interested agencies, successfully concluded a lengthy series of negotiations to establish an agreement with the Academy of Sciences of the Soviet Union to support cooperative projects proposed jointly by U.S. investigators and their Soviet counterparts in seven basic research fields in which the Soviets are doing outstanding work: mathematics, theoretical physics, Arctic research, geosciences, chemistry, life sciences, and basic engineering sciences. The agreement also specifies interchanges in the area of science policy research. The first meeting of the Joint US-USSR Commission on Cooperation in Fields of Basic Research, which oversees the NSF-Academy agreement, met here last week for the first time, under the chairmanship of OSTP Director Dr. Alan Bromley. That meeting confirmed our conviction that a firm foundation has been laid for long-term, fruitful cooperation between our two countries. We expect to be able to expand the list of fields that are the current focus for our collaboration to other fields as U.S. scientists and engineers gain more experience working with their Soviet colleagues.

Although lacking the drama of the political liberalization in the East, Western Europe's movement toward economic integration, often referred to as "Europe 1992," will also almost certainly affect U.S. science and engineering. It is useful to think of "Europe 1992" not as a specific terminal point in time, but rather as a process that has been going on for some time and will continue to go on after 1992, the year in

which economic barriers between the 12 nations of the European Community (EC) are scheduled to disappear. European scientists have already had considerable experience with pan-European research programs in which U.S. scientists have often participated. More broadly, scientific relations between the United States and Europe go back for more than a century. These relations have survived and prospered despite numerous sharp political and economic changes. They are also reflected in the strong bilateral programs that NSF has maintained for many years with virtually all Western European countries.

A few observers view "Europe 1992" as an attempt to create a "fortress Europe" that will exclude foreigners from any economic participation. We believe there are no grounds for such an alarmist scenario. Because of the quality of our science and engineering and our long-standing relations at both governmental and non-governmental levels, we believe that U.S. scientists and engineers will continue to be sought after as participants in cooperative projects after 1992. Indeed, EC officials are actively seeking areas in which joint projects can be established with NSF. Last month Commissioner Filippo Pandolfi, who heads the EC Directorate responsible for the Commission's science and technology programs met with NSF Director Erich Bloch to discuss informal mechanisms for moving in that direction. Even before that meeting, we had begun informal arrangements to participate in the multinational Arabidopsis Genome Project that is being carried out under the EC's Framework and Bridge programs.

While we believe U.S. investigators will continue to enjoy collaborative research opportunities in Europe, nevertheless the terms of their participation may very well change as additional research funds become available for European investigators. That is, while U.S. participation will be welcomed, it may not be considered as essential. One of the most significant changes could be psychological, as increasing numbers of young European investigators, both Western and Eastern, think in terms of Europe as a whole as an arena for their research rather than simply in terms of individual countries. In short, the movement toward integration in the West, coupled with the opening of the East, is leading inevitably to an enriched European research environment.

The National Science Board has established a committee charged with making broad policy recommendations to NSF to respond to European integration. NSF's Division of International Programs, which manages most of our bilateral agreements with European countries, has established a special Europe Task Force to assess opportunities and challenges for US science and engineering in the light of evolving events in Europe. That task force has already made two broad recommendations: (i) intensify information gathering, analysis, and dissemination about changes in Europe that are likely to affect U.S. science and engineering participation, and (ii) adopt measures to increase the two-way flow of scientists and engineers between the U.S. and Europe.

With respect to the first recommendation, the Director has decided to upgrade NSF's European office starting this summer so that we can better

determine the implications of rapidly changing events. With respect to the second, we are reexamining our existing cooperative programs with both Eastern and Western Europe in the expectation that strengthened bilateral relations will be even more important in the context of "Europe 1992." A high priority is to facilitate opportunities for young scientists and engineers to gain appreciable experience in Europe, starting at the graduate student and even the undergraduate levels. As I have already noted, NSF's disciplinary directorates currently provide support for their grantees to travel to Europe both for scientific meetings and occasionally for longer term research collaboration. We believe it is essential to involve larger numbers of younger U.S. investigators in such collaborative efforts. The overall, long-term objective is to produce a generation of U.S. scientists and engineers who are as comfortable working in Europe as they are in the United States, and who can maintain life-long ties with their counterparts there.

Finally, Dr. Bromley has asked NSF Deputy Director Dr. Fred Bernthal to chair an interagency task force on EC 1992 under the FCCSET Committee on International Science, Engineering, and Technology. The task force, begun under former NSF Deputy Director Dr. John Moore, is considering the impact of EC 1992 on U.S.-EC science and technology relationships.

To summarize, we are convinced that in the basic research areas that are NSF's principal direct concern, the net result of current movement toward integration in Europe is likely to be that we cannot take Europe as much for granted as we have in the past. We will have to work harder to

identify and take advantage of opportunities for collaboration. However, in view of the likelihood of an enriched research environment, such efforts will pay handsome dividends.

In the more applied areas, unresolved issues associated with standardization, regulation, and intellectual property rights, for example, still need to be worked out if we are to maintain fruitful cooperation with the 12 nations of the European Community after 1992. It is possible, indeed probable, that the EC will expand beyond its current 12 members, thus presenting similar issues elsewhere. Additionally, there is legitimate concern on the part of U.S. industry that its access to European research sites may be curtailed. The strength of the industrial components of the U.S. science and technology enterprise has an important bearing on the strength of the academic components that NSF supports directly. For that reason, we cannot be, and are not, indifferent to unnecessary barriers to industrial research participation in Europe by U.S. firms.

Our science and technology relations with Japan have probably been the subject to more intense scrutiny during the past few years than those any other country. NSF has had bilateral relations with Japan and has maintained an office at the U.S. Embassy in Tokyo for almost 30 years. However, we only recently established programs aimed at actively encouraging U.S. scientists and engineers to work in Japanese laboratories, rather than simply facilitating collaborations by those few U.S. investigators who are who are already convinced of the benefits of such collaboration.

In 1988 NSF announced a set of Japan initiatives negotiated with several government agencies in that country: the Japan Society for the Promotion of Science; the Science and Technology Agency; and the Agency of Industrial Science and Technology of the Ministry of International Trade and Industry (MITI). These initiatives, to which those agencies are making substantial financial contributions, aim to increase U.S. recognition of the potential benefits of cooperative research with Japanese institutions and build long-term relations between the U.S. and Japanese research communities.

In addition to enabling our scientists and engineers, including graduate students, to study the Japanese language, these initiatives provide opportunities for U.S. investigators to conduct research at a wide range of Japanese university, government, and industrial laboratories. The numbers of U.S. investigators going to Japan for long term working visits is increasing substantially as a result of these initiatives. Prior to 1988, only a handful of U.S. investigators went to Japan each year for long term research visits under Government programs. Between May 1988 and the present, NSF has made awards to support over 100 investigators for such visits. While the numbers are still relatively small, the trend is strong and positive.

In addition to these on-going initiatives, NSF and its Japanese counterparts are funding, on a pilot basis, a special program that will permit approximately 25 U.S. graduate students to spend this summer in

Japan where they will spend about half their time in language training and the other half working in Japanese research laboratories..

Recently, a group of U.S. investigators who have had substantial experience in Japan and of Japanese investigators with substantial experience in this country were surveyed about those experiences. That survey was conducted under the auspices of the joint US-Japan Task Force on Access under the U.S.-Japan bilateral science and technology agreement signed by President Reagan and Prime Minister Takashita in June 1988. The task force is chaired,on the US side, by NSF and is comprised of representatives of over a dozen Government agencies, including the Office of Science and Technology Policy (OSTP) and the Department of State. The survey involved 94 U.S. investigators and 137 Japanese investigators, all of whom had spent at least two months in the other country in government-sponsored and/or government-supported programs and facilities. Both sides indicated high regard for the research in their fields in their host institutions. Not surprisingly, both sides identified language as a major difficulty. Importantly, neither side noted any major problems with access to the facilities they required to conduct their research effectively.

Let me turn finally to the situation in Latin America, a region of considerable importance to the United States and one in which this subcommittee has been particularly interested. Most countries in the region, including all the major countries with which NSF has had cooperative programs, now have freely elected, democratic governments. Chile is due

to have its first full, free elections next year. Mexico, virtually alone among the major Latin American nations in having maintained political stability and its own brand of democracy for sixty years, is moving strongly toward a genuine multiparty system.

Like Eastern Europe, Latin America has several research centers with long standing traditions of scientific excellence, as well as groups that, while small, are considered first rate by international standards. Democratization in Brazil, Argentina, and now Chile, has made it somewhat easier for U.S. investigators to collaborate more freely with those groups. Unfortunately, economic conditions throughout the region remain a barrier to increased cooperation.

In Mexico, for example, a decade of economic stagnation has sapped much of the scientific community's vitality, and has led for the first time to a brain drain. Hyperinflation in Brazil and Argentina make it difficult to plan long-term cooperative projects. In short, democratization has obliged these countries to face up to the legacy of inflation and debt brought about by the reckless fiscal policies of predecessor governments. New democratic regimes have been forced to institute draconian economic measures that will affect support for science and technology in the short term. Nevertheless, selected cooperative programs in areas of particular strength in these countries can be advantageous to the U.S. and can also help restore vitality to the research communities in the countries themselves.

One promising portent for the future is that the governments of Mexico and Brazil in particular have explicitly recognized the importance of science and technology as investments for the future of their countries. This subcommittee is aware that in 1986, the Presidents of the United States and Brazil initiated a special Science and Technology Initiative designed to focus government-sponsored cooperative research in areas of special interest to both countries. The head of the blue ribbon panel of U.S. scientists who met with their Brazilian counterparts to work out details of that initiative was Dr. Allan Bromley, now President Bush's science advisor. A series of joint workshops in agreed upon scientific areas have set the stage for more substantial and focused cooperation between our two countries.

In Mexico President Carlos Salinas has, for the first time in Mexican history, appointed a scientific consultative council and a presidential science advisor. Dr. Bromley has had cordial, informal meetings with his opposite number from Mexico. As a result of their conversations, U.S. Government agencies and their Mexican counterparts have been asked to identify areas where enhanced cooperation between investigators in the two countries could lead to mutual benefits. The Mexican government has also initiated special programs to encourage cooperative research between universities and industry. If those programs develop successfully, they will broaden opportunities for cooperation between U.S. and Mexican scientists and engineers, through NSF's Science and Technology Centers, for example.

Primarily as a result of this committee's interest in Latin America, the FY 89 authorization bills for NSF and NASA directed the two agencies to commission an independent study of collaborative opportunities with Latin America. The results of that study, conducted by SRI, International, have been transmitted to you. A dismaying feature of that study was to document the drastic decline in opportunities for students from Latin American countries to pursue advanced study in the United States, a condition brought about in some measure by the continuing economic crisis in those countries. One of the great needs of the Latin American, and indeed of the Eastern European countries, is to broaden their human resource base for science and engineering. The United States has much to gain by providing opportunities for students from both regions to pursue advanced study here. Those who receive advanced degrees and later return home will contribute to the development of the capabilities of their own countries and are likely to maintain lifelong bonds with their U.S. colleagues. Those who choose to remain here either temporarily or permanently would be likely to make considerable contributions to our own research efforts.

Emphasis on the desirability of increasing the number of Latin American students in the United States underlines a key assumption that underlies all of NSF's bilateral cooperative programs: that the support of scientist-to-scientist contacts is a highly cost-effective means for establishing life-long bonds between U.S. and foreign investigators. Those bonds help assure U.S. access to science and technology throughout the

world. Several U.S. scientific societies have, in a modest way, promoted such contacts under their own auspices. International groups within both the American Mathematical Society and the American Physical Society are devoting particular attention to encouraging the work of their disciplinary colleagues in Latin America.

One particular project supported to enhance communication between U.S. and Latin American investigators is particularly noteworthy. During the past few years, NSF has supported the establishment of a computer network among U.S. academic scientists, known as NSFNet. That network provides academic investigators with access to computer facilities throughout the country, including the NSF-supported Supercomputer Centers.

A project supported jointly by NSF and NASA now links the Mexican National Autonomous University in Mexico City and the Institute for Advanced Technical Studies in Monterrey with NSFNet by means of a transmitter at the National Center for Atmospheric Research in Boulder. The Mexican government is developing a network based on nodes at Mexico City and Monterrey which, when completed, will provide university scientists throughout the country with the same access to NSFNet as their U.S. colleagues currently enjoy. Last year, NSF and the Organization of American States organized a working meeting in Costa Rica with the aim of using the lessons learned from the U.S.-Mexican network to extend the connection throughout the hemisphere.

One result of democratization in Latin America, as in Eastern Europe, has been that the respective governments are now openly acknowledging their severe environmental problems and are requesting international assistance to alleviate those problems. Latin American countries, particularly tropical countries such as Brazil and Mexico, not only suffer from serious urban pollution, but are also threatened with severe loss of biological diversity with the seemingly relentless destruction of their tropical ecosystems. Both countries also have excellent groups of scientists working in the area of ecology. Enhanced cooperation with those groups could not only add to the fundamental knowledge of U.S. scientists, but could also make a significant contribution to the problem of preserving the quality of the global environment.

One week ago, President Bush hosted an unprecedented meeting of senior science, economics, and environmental officials from 20 countries and two international organizations to discuss the scientific and economic factors underlying global change. One clear conclusion of the White House conference was that the world's developed countries cannot address much less resolve the serious problems posed by global environmental changes without the full and active participation of scientists in less developed countries, including Latin America.

Obtaining such full and active participation will require that we work with the small but dedicated and excellent groups of scientists in those countries to help them expand their numbers and develop their potential to the fullest. Doing so should not be considered an act of

charity, but rather as an essential -- and eminently cost effective way -- to help resolve one of the most daunting scientific challenges we have ever faced. NSF's bilateral programs provide a sound basis for our participation in such a concerted effort.

Twelve years ago when the U.S. Congress enacted Title V of Public Law 95-426, it recognized the desirability for the United States to link science and technology more closely with American diplomacy. The White House Conference on Science and Economic Research Related to Global Change is only the most visible demonstration of the fact that today linkages between science and technology and international relations have become not merely desirable, but essential; not only for the United States, but for countries throughout the world.

Mr. Chairman, your letter of invitation to these hearings asked whether new legislation ought to be enacted to stress the importance of the rationale that underlies Title V. I do not believe new legislation is necessary, nor do I believe that any such legislation would serve its intended purpose.

The vitality of U.S. science and technology is due in part to the fact that they are highly diffuse and decentralized enterprises. The academic, industrial, and government components of those enterprises are motivated by different if closely related incentives. For example, although six Government agencies account for more than 90 percent of the

Federal Government's budget for research and development, more than 20 agencies have some stake in this country's science and technology activities. Under those circumstances, any attempt to focus our rich science and technology resources single mindedly on the pursuit of specific foreign policy objectives is a daunting task.

Mr. Chairman, that task, while daunting, is worthy of our best efforts. But it cannot be simplified by new legislation. Rather than trying to recast Title V in some new form, we all need to work harder to be true to its underlying spirit. Hearings such as this one serve an essential purpose in reminding us of the importance of Title V to this Nation -- and to the world. On behalf of the National Science Foundation, I am grateful to have had this opportunity to appear before you today and to receive your renewed assurance that our efforts to make more use science and technology in the service of U.S. foreign policy are eminently worthwhile.

Mr. HALL. Dr. Ries, thank you very much.

Dr. Boright, you know we are having funding problems with science and technology cooperation with Eastern Europe due to Section 614 of the State Department Appropriations Bill and due to the fact that Congress did not repeal that section, which seems to have a result in Poland being cut from $1.5 million to about $600,000; Yugoslavia is cut from $2.2 million to $1.4 million and Hungary is cut from $300,000 to zero.

I guess that my question is: what do you expect will be the results of these funding cuts to Poland, Yugoslavia, and Hungary, and what is the status of our cooperation with these countries?

Mr. BORIGHT. Thank you, Mr. Chairman. As they say, I am glad you asked.

The program that we have with Yugoslavia, as you know, is older than the other two, or at least in its present incarnation. I will speak for a second about the ups and downs of our U.S.-Poland relations in a minute. But with Yugoslavia, we have a very active and high quality program that clearly has a very substantial demand across a fairly broad spectrum of American technical agencies for cooperation. There, this gap between what we really thought we had and what we in fact have in hand now is particularly painful because of the very concrete programs that we have already underway or in our in box.

In the case of Poland, we had a program earlier. We are restarting it now. We had expected to move much more quickly. The Polish scientific community has very good relations with American counterparts, and we also expect that a very substantial number of excellent proposals will continue to grow. I must say, as having had the honor of chairing the American side of the joint commission just recently, I am particularly tenderized on the subject.

In the case of Hungary, we are—just a small correction of what you just said. Your figures are basically right. We are asking for authority to transfer a small amount to Hungary to organize and work with the Hungarians on a first year initiation kind of effort. Again, from my experience at NSF and elsewhere, I already know that the excellence in the Hungarian science establishment is quite clear. That is a program that could also grow significantly.

The situation right now in all three and certainly here is disappointment. Thank you.

Mr. HALL. Ms. Wince-Smith, I think you recently reviewed a Japanese proposal to enhance international cooperation in automated manufacturing, which is one of Japan's real strengths. What is your view of this proposal and what is the view of U.S. industry? I am sure you took a shot at them and got their input on it.

Ms. WINCE-SMITH. Mr. Chairman, we were very surprised when we heard about this proposal because we have, as we have all mentioned this morning, had a government-to-government science and technology agreement with Japan that President Reagan and Prime Minister Takeshita signed, and one of the areas that is highlighted for cooperation is manufacturing science and technology. The U.S. Government was not really aware of this initiative until fairly recently. It has been put together by MITI involving a number of private sector companies in Japan.

Dr. Bromley asked the Commerce Department to put together an effort with U.S. industry, a broad range of industrial participants, to get their views and assessments on the proposal. We did this out of the National Institute of Standards and Technology just this past Monday. We had about 100 representatives from companies covering the whole range of industries that are involved in the manufacturing arena, particularly those in the information world.

There was a broad consensus that this area, the areas of research proposed in the MITI activity, would have a great impact in the future on our competitiveness position. Particularly, the Japanese are interested in highlighting work in software and systems integration, where in our research base, we still have a competitive advantage.

The consensus that we heard from industry on Monday was that if we are interested in collaborating with the Japanese in this area, we have to look very carefully at the subjects and how this is being put together so that there will be a real quid pro quo in the proposal. Right now, the majority of the work as proposed by MITI is more in areas where the U.S. has a lead, not those in which the Japanese are ahead. For instance, there is no focus in the proposal on addressing the commercialization aspects or the technology transfer end, whereas we all know, the Japanese have tremendous capability and strengths.

Next week when we meet with the Japanese, we will be raising this under the official auspices of our head of government agreement.

Mr. HALL. Let me recognize the gentleman from California, Mr. Packard.

Mr. PACKARD. I am not sure which one would be the appropriate person to answer this, but whoever feels to do so may respond. I would be interested in what your thinking is on U.S.S.R., Japan, Europe, Eastern Europe particularly, Canada, and others as it relates to the Moon-Mars exploration program. I would be interested in knowing what our attitude is there in relation to those countries and others.

Dr. Boright?

Mr. BORIGHT. Mr. Packard, you know undoubtedly that the President has announced a general openness to explore with all countries, including in particular the ones you listed, options for possible cooperation in this project. Our own thinking, you must understand, is at an extremely early stage. What we see for ourselves is a period of some years where we look at the overall technological options and paces and, needless to say, at the resources that might be involved. It is very difficult to answer that question now not having even our own blueprint in order. I should say that we do have now a major relationship with the Europeans, Canadians, and Japanese in the space station program. We are learning almost by the day how to get along in a significant relationship like that. It really is a learning experience.

With the Soviet Union, we obviously do not have that. There are many, many questions that need to be answered about how you do this in a way that does not leave the program vulnerable to uncertainties, which, of course, we have seen programmatically and politically over many years.

It is a very hard question to answer right now.

Mr. PACKARD. Thank you.

Ms. Wince-Smith, to what extent have COCOM restrictions affected the exchange of information and technology, and with the new global environment that exists, are you and the Commerce Department looking at or suggesting that we may wish to change some of those restrictions or some of COCOM's principles relating to global exchange?

Ms. WINCE-SMITH. As you know, of course, COCOM is primarily a vehicle to address the actual sale of finished technology goods. In terms of the science and technology exchange area, I do not think that the COCOM process has had any detrimental effect in terms of collaboration among the Western allies, our partners in Europe and Japan.

There is no question that in the past, with respect to the Soviet Union and with Eastern Europe, there were areas of cooperation that were considered to be sensitive for national security reasons—obviously, the dual use technology field would fall into that category along with some of the advanced information computing technologies.

Commerce is very much involved in taking a leadership role inside the government on all the issues pertaining to reassessing our export control policies to make sure that they are consistent with what is already available in the world in terms of technology sales, but also in response to the political changes that are occurring in Eastern Europe and the Soviet Union. We hope to see some changes on that front.

In terms of basic scientific collaboration, this will be reflected in that arena as well.

Mr. PACKARD. Are there other vehicles other than COCOM — and I am aware that COCOM addresses primarily instruments and products and their sale and exchange—but are there other processes that are inhibiting the exchange of information and is the approval process being reevaluated to simplify that process of exchange of information? If so, what are those changes?

Ms. WINCE-SMITH. As I said, in the COCOM process, I know that they are investigating simplification of procedures. In terms of the science and technology information area, it is my understanding that that has not come under the purview of COCOM but is addressed in some other vehicles.

Mr. PACKARD. It is those other vehicles that I am wondering about as to whether or not we are reevaluating to simplify that process. Maybe it has not been a problem. I would be interested in knowing if you feel that there have been restrictions in the exchange of information through any process, not just COCOM.

Ms. WINCE-SMITH. There have been some restrictions in the past on the types of information that have been presented at scientific conferences and the participation of scientists and engineers from the East Bloc countries. Those issues are being addressed inside the U.S. Government through the National Security Council mechanism which all the agencies participate in. Again, in view of what is going on in the political environment, I would be predict—no, I can't say where it is at this point— I expect that we will perhaps be looking at that in a different light.

Mr. PACKARD. Dr. Boright, you may want to elaborate a little on that. I understand that there are some foreign governments that are bypassing some of the processing of science and technology simply because of the difficulty of following the normal process. Thus, they simply avoid going through our governmental science and technology approval process.

Mr. BORIGHT. The point that Ms. Wince-Smith made is accurate, I think. COCOM is a very specific exercise related mostly to concrete products.

Under the NSC&PCC committee that I mentioned earlier, we have two subcommittees, interagency committees, one of which deals with the whole range of questions related to science and technology relations with the Soviet Union, and another related to Eastern Europe. I can not tell you that we have changed our procedures, nor am I absolutely sure that we should now.

What we need to do in implementing our procedures and in making our judgments as to what we think is appropriate to do on balance and what we do not think is appropriate is to take into account our best information as to where we are and our best information as to where we are going to be in the future. Obviously in Eastern Europe, things have changed very dramatically.

We still have the process in effect to review cooperative arrangements. I think it is fair to say that it has been a cautious one in the past and, clearly, that is going to be reflecting reality.

Mr. PACKARD. Dr. Ratchford, for years I have suggested that we develop some kind of an international agreement of property rights, patent protection, and so on. I do not think we are any closer to that now than we were years ago when I discussed it with some of the Japanese representatives when we were over their and with our own representatives.

I think that you have done some review of it, and I would be interested in your evaluation as to whether we are still lagging behind in terms of differences between our countries in terms of protection of property rights. You also mentioned in your testimony that you are developing a streamlined language that addresses that issue. I would be interested in having you elaborate on that.

Mr. RATCHFORD. Thank you, Mr. Packard.

The testimony addressed the specific issue of intellectual property rights clauses in science and technology agreements, most of which are agreements that address cooperation in the basic sciences. Let me say just a word or two about the nature of the problem that we face and our general approach to dealing with it.

First, there are two categories of countries that we deal with in the intellectual property rights arena. First are the developed, industrialized countries. Generally, those countries provide adequate protection for intellectual property. There may be some differences, especially in fast moving fields such as biotechnology. There are some differences in process protection versus product protection, and so on.

I do think it is fair to say that given agreement on some basic issues as to how we reward the institutions and individuals involved in that cooperative research, we should be able to overcome the hurdles that we face there. The committee of the FCCSET, CISET, is about finished with a review, and I am optimistic that

the result of that will mean that we will be able to overcome the delays that have plagued us with renewal of a number of our current science and technology agreements.

The question of intellectual property rights issues with those countries that do not currently adequately protect IPR is more difficult. That is being approached across the government on several fronts.

First is bilaterally, in the context of trade talks and in the context of other agreements as well as the science and technology ones. It is also being approached in the GATT round of negotiations.

That will be a somewhat more difficult problem to solve. We are, however, attempting, and have developed in some cases, temporary fixes.

Ms. Wince-Smith mentioned the case of India. What we have done there because there are substantial areas of intellectual property which are not protected under Indian law is that we have said that we will not have specific cooperation in our science and technology agreements in those areas. Therefore, we avoid the problem by avoiding the area of cooperation.

Mr. PACKARD. Do we find it impossible to develop an international patent protection process or property right protection process? Is that not doable?

Mr. RATCHFORD. I can not answer that myself. I have asked similar questions to experts in the intellectual property rights field. I am told that most experts believe that over the next decade or so that there will be an evolution toward a unitary, worldwide approach to the protection of intellectual property.

As you know, there is a fundamental difference between the U.S. system and others, namely, the distinction between the individuals that file for a patent first versus making the discovery first. In this particular case, we are out of sync with the rest of the world. That particular issue will have to be resolved, I suspect, before we have a unitary system worldwide.

Mr. PACKARD. Then there is some hope?

Mr. RATCHFORD. There is always hope.

Mr. PACKARD. I have two questions, Mr. Chairman, that have been submitted to me. One is by Mr. Walker. I guess both are by Mr. Walker.

Mr. HALL. Mr. Walker and Mr. Sensenbrenner have both yielded their time to you.

Mr. PACKARD. Thank you. I will take care of their duties if you will yield some additional time. This also might be a good time to ask that their statements be entered into the record. Mr. Walker wanted to be certain that the record was left open. That would probably be true of any member of the committee.

Ms. Wince-Smith, you mentioned how the Japanese Government is organizing international efforts such as the Human Frontiers program and a new IMS program. Can you tell us a little more about that and what its commercial ramifications are? You may wish to address why such an international government-supported project would not fall under the U.S.-Japan science and technology agreements.

Ms. WINCE-SMITH. I have touched a little on that in response to the chairman's question, but let me expand a little more if I may.

The whole area of manufacturing is the critical determinant of our ability to produce world-class goods and services into the next century. On the domestic front, the willingness of our industry to incorporate advanced manufacturing techniques and practices into their operations is very deficient, viz-a-vis what is going on in Japan and Europe.

This is an area that deserves our utmost attention in terms of our science and technology priorities. I believe it is going to be one of the key issues that will be looked at under the industry and technology committee that has been formed under the new FCCSET coordinating group.

In view of this fact that manufacturing is so critical to the future trade situation—in order to get technologies translated into products, you have to get them out into the market place in a very timely, cost-efficient way. Doing it with advanced manufacturing is the way to proceed.

The Japanese have excelled in applying manufacturing to this process. As you know, that is one of the reasons that we have trouble in the semiconductor area. In terms of the basic research and design, we still lead the world, but we have not done as good a job as our competitors in actually producing our semiconductor chips in high volume, high quality, cost-efficient yields.

However, in the research environment, we are still doing the best basic research in the world in the most advanced manufacturing area, in our universities primarily and in our national labs, particularly in terms of the use of intelligent systems. I mentioned earlier the software and our ability to do systems integration, but that has not yet been translated into our industrial environment. That is a problem that we have to work on domestically.

What the Japanese MITI proposal has done is targeted our advanced capabilities in the research area throughout the U.S. as the focus of a collaborative effort. It has not targeted this issue of the application in industry where they have so much to offer.

In the view of the experts in industry as well as many in the government, the proposal as it is constituted now is very skewed in favor of the Japanese; that they will in effect obtain through this activity if it goes forward the way they propose not only a road map of all the work that is being done in our universities, primarily supported with government money, but also some of the advanced work that is being done in our industry that is not yet in the applied stage. It is very important for us if we want to proceed to structure this in a way that we obtain access to the good work that they are doing in manufacturing on the applied developmental end.

Mr. PACKARD. Do we see a willingness on the Japanese part as they negotiate to share their strengths as well as having us share their weaknesses?

Ms. WINCE-SMITH. Well, in my view—this is my personal view and others share this view among industry and some in the government—the Ministry of Industry and Trade in Japan has never discussed this proposal with the U.S. Government. They have gone directly to a professional society, the Society of Manufacturing Engi-

neers, and asked them to coordinate on behalf of the U.S. for this proposal. This is why it is so important to bring this activity under our head of government agreement so that we can negotiate on behalf of our industries, our universities, and our overall interests and have a coordinated approach with the Japanese. Otherwise, they are going to go to individual companies and universities and there will be no systematic response.

Mr. PACKARD. In your judgment, is this problem unique to Japan, or are there other countries that we are dealing with and sharing information with where we have a problem of the same nature, such as West Germany or other industrialized countries?

Ms. WINCE-SMITH. Every country, obviously, wants to put together research proposals that give them a comparative advantage. Then it is in the negotiating process that you work out a win/win situation so that both benefit.

I would say that our European partners, I think, are much more straightforward in coming into the proper channels and negotiating through the relevant vehicles. I might add in this case that the European Community shares the identical concerns that we do over the intelligent manufacturing systems proposal.

Mr. PACKARD. Thank you very much.

Dr. Boright, Ms. Wince-Smith noted in her statement the requirement that the Secretary of State shall develop a recruitment policy that encourages scientists and engineers from other Federal agencies, academic institutions, and industry to apply for assignments at embassies of the United States. Are we making progress in this area? If so, what? Also, what are some of the other problems that relate to that? I know that other countries have a little different system than we do, and I would be interested in knowing whether we need to reevaluate our system or if the existing system is working.

Mr. BORIGHT. That is a subject that I have spent a lot of time on and others have. Taking your last point first, it is quite correct that our system is different, certainly numerically and in terms of what we expect from a science office. We have a different approach.

Several other countries, particularly here because we have such a large science and engineering enterprise containing so much interest to these countries, have large offices here. I can go into some of the lists of which you are probably aware.

Mr. PACKARD. Their embassy people become almost ambassadors of science and technology, whereas sometimes ours do not.

Mr. BORIGHT. They certainly fulfill many functions as sectorial reporters and gatherers of public sector information, as well as ambassadors. In the case of France, for example, they have essentially one person per major scientific sector.

Frankly, we are not funded, to be very concrete, to be able to do that, nor has there ever been a judgment by this or any other Administration and Congress in combination that we really want to have that kind of an ambitious approach. What we do want from our science counselors—and they are relatively few as you pointed out, somewhere around 34 or 37 or something like that—is to be very good general science reporters on the major budgets, priorities, directions, developments and opportunities in the host coun-

try. And frankly, we depend very heavily on these people to represent U.S. interests.

We shower them with instructions, saying, "Please go in and help to convince your host government to join the Montreal Protocol," and so on. There is a lot of that kind of work.

In terms of the specific question of recruiting scientific capability from other U.S. agencies and from outside the government, we have taken steps to publicize and do that. To be very frank, it is hard to do it in significant numbers when we have such small numbers of funded slots to start with.

I could mention a few modest things that have been done that I think are worthwhile. One in particular is an exchange arrangement with Los Alamos Laboratory where we are sending one of our experienced people down to work with them for a year and one of their long-time technical program people is going to spend some time in our science section in London.

I wish that I could give you a whole list of examples like that. There are not as many as I would like.

Mr. PACKARD. Thank you very much.

Mr. RATCHFORD. Mr. Packard, if I might add one comment to that—

Mr. PACKARD. Please do.

Mr. RATCHFORD. It is clear that we in this country do not take nearly as seriously as almost all of our major trading partners this issue of adequately staffing our embassies overseas with individuals expert and trained in science and technology and industrial issues. It is a hard issue and one that has to be developed by both the Administration and the Congress in cooperation.

It is a deficiency that, I think it is fair to say, a number of us recognize. We also recognize that we are not as effective in applying science and technology to foreign policy as a result. I hope that we will be able to do something about this in the coming years.

Mr. PACKARD. My fear is that those who represent us in our embassies have the mind set that we are superior in basic and fundamental information and technology and have nothing to receive from the countries but lots to give. I think that perception persists in other countries, too, but they send their people here to gather and to receive much better than we do.

Yet, when a country like Japan and some others do take a lot of technology from us and exploit it and profit from it, we then complain. I think that part of it is our own fault because of our own mind set that we tend to feel that we have got so much to give but they do not really have so much to give us.

They have got great scientists in some of the countries that have been mentioned. I have found that Czechoslovakia and Hungary are in some instances superior to us in terms of their knowledge base and their scientists, not in numbers, but certainly in quality. They have a lot to offer. I suspect that we do not really give them that kind of credit.

Mr. Chairman, you have been very generous with your time with me. I would like to conclude by saying that the testimony today has been extremely effective. I appreciate all four of them.

Mr. HALL. Dr. Ratchford, you also spoke about the need to involve our international partners in initial planning and design

phases of big projects, and of course, you know that we are right on the eve of going into some legislation on the Supercollider. I guess it is fair to say that we did not involve our international partners in any such initial planning or design on the SSC or the space station.

I guess it is a difficult thing to do because you did not really know if we were ever going to get them off the ground to start with—no pun intended there. On the SSC, you almost have to wait until you are pretty well assured that we are going to have a project and that we are going to go forward with it and that we are not going to get them out on a limb and then abandon them where they would have wasted a lot of their time and technical ability in the international planning or design of these phases. Is there any cure for that, and what new projects can we do this early joint planning on in big science or so-called small science?

Mr. RATCHFORD. That is an excellent question, Mr. Chairman. Let me say just a word or two about the strategic approach that one might take to the megaprojects issue.

There are at the present time, and there will be over the next 10-20 years, a large number of the so-called megaprojects. Some are related to specific pieces of equipment like the SSC. Others have a diffuse or geographically diverse aspect, such as research on global change or the human genome project.

It is our view that we at least need to look carefully at all of these projects together, with the expectation that it is probably easier to solve them all—conceptually at least—than it is to solve them one at a time. What I mean by that is the possibility of looking at these projects in the context of sharing them with other major nations around the world, sharing them not only as far as location is concerned, but also in the more important area of funding.

Not only this country, Mr. Chairman, but most of our major trading partners, are experiencing a crisis in the area of funding of science and technology, specifically in the competition between the megaprojects on the one hand and the individual investigators on the other. More and more around the world, there is demand for dealing with this issue on an integrated basis.

I think it will take time. This will not occur overnight. It is a very difficult issue and one that will probably not be solved in a strategic sense until a number of the current activities, such as the SSC and the space station, are well on their way. I do not think that you will find anyone who says that we should stop work on any specific megaproject at the present time in order to reach this happy strategic solution at some time in the future. There will no doubt then be simply a grandfathering of projects which are off the table as far as current discussions are concerned.

I do not want to confuse the issue by having you think that we are thinking about restructuring the arrangements for megaprojects which are already underway. Rather, we are dealing with those that are out a decade in the future.

Mr. HALL. But there was some complaint by some circles that we did not involve them in the early planning. I really do not see how you could have. I am in favor of your doing it.

In the first place, on the SSC, we do not know who our partners are going to be. We know who we want them to be and who we anticipate they are going to be, but I think they would have thought us a little presumptive if we told them we were going to build the largest accelerator in the world and going to give them a chance on helping to finance it a little bit later and intrigued them over here into the initial planning and designing. I think that would have been a hard thing for you to have done.

Mr. RATCHFORD. You have correctly identified the difficulty of the task.

Mr. HALL. Dr. Ries, I don't know if you were so concise and to the point that no one had any questions to ask you, or if you got us so confused we didn't know any questions to direct to you.

[Laughter.]

Mr. HALL. We do thank you for your testimony. You cited a survey that indicated some open access between U.S. and Japanese scientists in government-operated labs. Really, the place we need to open is the private sector over there, isn't it? Isn't that where much of the work is being done and isn't it still fairly closed to us?

Mr. RIES. Thus far, Mr. Chairman, we have been able to attract both academic scientists to spend time in Japanese laboratories and a rather sizeable proportion of government scientists to go to Japan. We have been singularly ineffective in attracting, at least under our government- sponsored programs, U.S. industrial researchers to spend time in Japan. We are continuing to work with several large groups, the American Electronics Association, the Industrial Research Institute, and a number of others, seeking their help in trying to find out why we have been this ineffective with regard to U.S. industrial researchers.

In some cases, private industry feels that they can make those kinds of arrangements themselves as needed and perhaps feel that they do not require U.S. Government support or intervention in their industrial business. We think, though, that there are opportunities that we could be helpful in.

Mr. HALL. The language barrier, the lack of foreign languages, is one of the major impediments, I guess, in taking advantage of research opportunities abroad for our people. I want to ask: where NSF is expanding the pilot program to send more of our graduate students there for language training, does Japan help with that? Do they provide any financing for that effort?

Mr. RIES. Absolutely. Let me tell you about a program that we have just initiated and in which we will have our first pilot effort this summer. It is focused specifically on graduate students in science and engineering.

Through a national competition, we have advertised the availability of what we are calling the NSF Summer Institute in Japan, allowing 25 graduate students to spend about two months, roughly.

Mr. HALL. Do you get good response from that?

Mr. RIES. Absolutely. In one month, we had probably on the order of 90-100 that we could have sent, but had to pare that number down. The financing we had available was up to 25. We would hope to see this program expand considerably.

To answer your second question about Japanese support, we are providing orientation, assistance, travel costs, and so on to get the

group to Japan. The Japanese participating agency, which happens to be the Science and Technology Agency of Japan, is in fact providing the room and board costs in their science city, Scuba City, where the group will be housed, spending half days studying the Japanese language and studying about how science and technology is organized in Japan, and the second half of the day, each of them will depart in diverse directions to particular laboratories related to their own training. That is: chemists will go to chemical laboratories, electrical engineers to electrical engineering laboratories.

These are largely government laboratories but include some Japanese industrial laboratories as well. So half days will be on orientation and language and half days will be on actual research experience.

It has not occurred yet. We think this is a great idea and the Japanese side has been very supportive financially, split about 50/50 in cost.

Mr. HALL. That's great.

I would like to go on into some of the problems of Eastern Europe with you. They are in the beginning stages of their democratic process, and it seems they are at almost a major disadvantage. I don't know whether we are expecting too much for their scientists to immediately adapt themselves to our competitive grants and peer review or whether or not we ought to have some intermediate procedure to set up to help them through this transition period or not. That is something that we may direct to you and others later.

You have all been very gracious, and we all recognize that your fine, trained minds are a real asset, a real treasure of this country. We appreciate your being in the sector you are in when you might be on the outside making four times as much money as you are making. You are certainly rendering a service here, and you are a great help to us. We appreciate your time and your effort.

Before closing, does the gentleman from California have anything else?

Mr. PACKARD. I have one short question of Dr. Ratchford if I may, Mr. Chairman.

Mr. HALL. I thought you were couched for it over there. I just got you in my peripheral vision.

[Laughter.]

Mr. PACKARD. Other than the State Department, NIH, and NSF members, are there other members of CISET?

Mr. RATCHFORD. Yes, sir. There will be all of the major agencies that have an interest in science and technology and international activities.

Mr. PACKARD. Is that still being formulated?

Mr. RATCHFORD. Yes, sir. Just on Tuesday of this week, we had a meeting of all of the chairmen and vice-chairmen of all of the FCCSET committees. They are in the process currently of identifying the other members of those committees.

The CISET in particular should be up and running in two or three weeks. In fact, one of the issues that it will be dealing with is this issue of the megaprojects.

Mr. PACKARD. Thank you very much.

Thank you, Mr. Chairman.

Mr. HALL. We do thank all of you for your time and thank the staff for their good preparation.

We will hold the record open so that other members of the committee might have an opportunity to address further questions to you in writing. If they have such, we will submit them to you. Once again, we thank you all.

[Whereupon, at 11:40 a.m., the subcommittee was adjourned.]

APPENDIX I

THE WHITE HOUSE

WASHINGTON

March 23, 1990

Dear Mr. Speaker:

In accordance with Title V of the Foreign Relations Authorization Act of Fiscal 1979, as amended (Public Law 95-426; 22 U.S.C. 2656c(b)), I am pleased to transmit the annual report on international activities in science and technology (S&T) for fiscal year 1989.

A characteristic feature of our age is the unprecedented rate of change in science and technology. In 1989, however, the rate of change in foreign affairs, particularly in Eastern Europe, has surpassed even that of science and technology. These remarkable changes in Eastern Europe have provided expanded opportunities for S&T cooperation with countries of the Eastern Bloc.

For example, on July 15, 1989, during my visit to Budapest, Hungary, I committed the United States to work with Hungary to expand bilateral research exchanges between our two peoples. Subsequent negotiations resulted in the signing of an umbrella S&T agreement less than 3 months later. In addition, because of growing concern about the environmental problems that plague the countries of Eastern Europe, I announced the creation of a new, independent Eastern European Environment Center in Budapest, along with initiatives to improve the environmental quality of the historic city of Krakow, Poland. We will continue to look for opportunities to integrate mutually beneficial science and technology cooperation with our broad foreign policy goals that are aimed at encouraging independence, democratization, and economic growth in emerging market economies of Eastern Europe.

My desire to preserve and improve humanity's common heritage and to address issues of the environment and global change found expression in a number of other activities. During the Paris Economic Summit, I joined other heads of state in calling for decisive action to understand and protect the earth's ecological balance. The United States was instrumental in establishing the Intergovernmental Panel on Climate Change as the primary international forum on this topic. These and other efforts highlighted in this report emphasize the need for nations to work together to understand the interconnected earth system and the ways in which human activity is influencing that system.

Because science and technology are truly international activities, it is frequently the case that scientists and technologists collaborate more closely with colleagues on the other side of the globe than with those at the other end of the hall. This international dimension of science is built on the person-to-person and institution-to-institution bonds that are formed through shared education, collaboration in research and development, and communications.

We in the United States pride ourselves on open access to our educational institutions, not only for students of this country but for students around the globe. Many foreign students have been eager to take advantage of this access, because it remains a fact that the United States has the best system of graduate education anywhere in the world.

The free flow of students finds a parallel in the free flow of ideas around the world today, particularly in the area of basic scientific knowledge. Much of the international character of science derives from its universality. The United States is firmly committed to the free and open international flow of basic scientific knowledge.

This philosophy also underlies the U.S. approach to a very important subset of our scientific efforts today -- namely, the megaprojects in science, such as the Superconducting Super Collider, the human genome project, and Space Station Freedom. The results of these projects are a global resource adding to the knowledge base of all countries. We are moving toward a day when the responsibility for supporting large basic science projects will be distributed around the world, reflecting the truly international character of modern scientific research and the shared financial and intellectual underpinnings of that research.

Perhaps the most important element of federally funded international cooperation in S&T is the over 600 bilateral science and technology agreements involving more than 20 U.S. agencies, 120 foreign countries, and numerous multilateral organizations. These agreements -- many of which are highlighted in this report -- differ from one country to another, reflecting the state of that country's development and its past relations with the scientific community in the United States. However, there are several broad principles that apply in all our international science and technology agreements: comparable access, shared responsibilities for both basic and applied research, adequate protection and fair disposition of intellectual property rights, and effective protection of sensitive knowledge.

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These agreements provide exciting opportunities for cooperation between the United States and the rest of the world, but we must remain cognizant of the fact that the global marketplace is becoming increasingly competitive. The United States still has the strongest science and technology enterprise that the world has ever seen, but we no longer are in a leading position in all fields. By concentrating resources and focusing efforts, other nations have succeeded in equaling and in some cases surpassing us in specific areas of research and technology.

This is part of the orderly development of nations and is due, at least in part, to the help that we provided to other countries since the end of World War II. But the internationalization of the marketplace emphasizes that we can no longer take our leadership for granted. In an increasingly competitive world, only a continuing effort to remain at the forefront of science and technology will ensure our economic and military security.

It has become increasingly clear that science and technology, the economy, and foreign relations are inextricably intertwined. Policy decisions must be made with a clear appreciation of the scientific and technological issues surrounding those decisions. We must find more creative and effective ways to ensure that science and technology are an integral and important part of our foreign policy around the globe. We have begun that process in 1989, and I look forward to continuing that effort in 1990 and beyond.

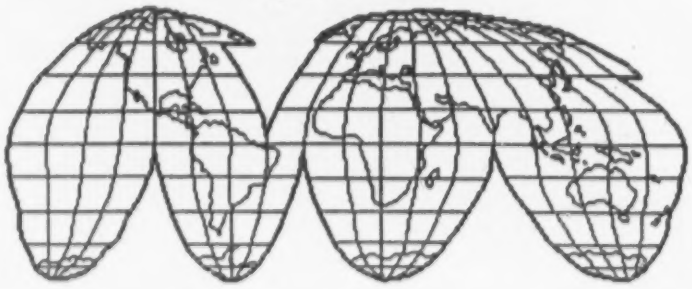
Sincerely,

GEORGE BUSH

The Honorable Thomas S. Foley
Speaker of the
House of Representatives
Washington, D.C. 20515

TITLE V REPORT
SUBMITTED TO THE CONGRESS MARCH 23, 1990
EXECUTIVE SUMMARY

Science, Technology and American Diplomacy



Eleventh Annual Report Submitted to the Congress by the President Pursuant to Section 503(b) of Title V of Public Law 95-426

1990

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SCIENCE, TECHNOLOGY AND AMERICAN DIPLOMACY

"Scientific and technological achievement have always been at the very heart of our nation's pioneer spirit, pushing the boundaries of our knowledge, creating economic opportunity, and increasing our standard of living."

President George Bush before the Joint Session of the United States Congress, February 1989

"Science - the pursuit of knowledge - is inherently international and it thrives on cooperation....science and technology agreements have also become indispensable tools of U.S. foreign policy and, occasionally, the diplomatic instrument which allows us to maintain linkages with countries during the most turbulent periods of our relations."

Dr. Frederick M. Bernthal, Assistant Secretary for the Bureau of Oceans, and International Environmental and Scientific Affairs, Department of State, before the Committee on Science, Space and Technology, United States House of Representatives, September 1989

"We need to develop a longer-range strategic vision of science and technology and of their present and potential contributions to our economic well-being, our national security, and to the health and quality of life of our citizens..."

"We need a comprehensive approach to international scientific cooperation that can become an integral part of our foreign relations activities. Further, we should improve our ability, as a government, to utilize science and technology as a tool in attaining the goals of U.S. foreign policy."

Dr. D. Allan Bromley, Assistant to the President for Science and Technology, before the Committee on Commerce, Science and Transportation, United States Senate, July 1989

Science, Technology And American Diplomacy

EXECUTIVE SUMMARY

This is the eleventh annual report on Science, Technology and American Diplomacy, in response to Title V of the Foreign Relations Authorization Act of 1979, as Amended.

Chapter 1 of this year's report responds to the legislation with a highlight summary of science and technology personnel issues, significant cooperative science and technology developments, economics, statistics and other foreign policy implications of Fiscal Year 1989 activities, adequacy of funding, and responses to associated directives. Chapter 2 examines in greater detail selected significant topics in international science and technology. Chapter 3 provides details of bilateral science and technology cooperation for 25 selected countries. Chapter 4 addresses international science and technology activities of 22 U.S. Government agencies, including a detailed summary of S&T activities of U.S.A.I.D.

Personnel

During Fiscal Year 1989, the Department of State employed 154 full-time Civil Service and Foreign Service employees in the areas of science, technology and environment, including 34 full-time science and technology officers and fisheries attaches at 25 missions worldwide. Additional U.S. agencies have stationed roughly 15 employees in U.S. embassies to support their respective interests. In order to address the increasing impact of science and technology in foreign affairs, the Department of State established within the Foreign Service a separate occupational category for Science and Technology officers. The Department of State also is working with Congress to develop a Science and Environment Resources Package which is intended to project all Departmental resource requirements, both in Washington and in overseas posts, for the conduct of scientific, technological and environmental affairs.

In Fiscal Year 1989, the Department of State made significant progress in support of the objectives of Section 4(b) of Executive Order 12591, entitled "Facilitating Access to Science and Technology." Currently, there are personnel from the public and private sector on limited Foreign Service appointments serving in Korea, Paris, Vienna, Mexico, Tokyo, and New Delhi.

Experts from the public and private sector are also given short-term assignments at embassies overseas to study and report on selected S&T topics, particularly emerging technologies.

Continuing educational and technical training activities for science and technology officers are ongoing areas of emphasis. The third consecutive annual course entitled "Science, Technology and American Diplomacy" was sponsored by the State Department's Foreign Service Institute (FSI) in June, 1989. In September, 1989, the Department of State held its annual Science and Technology Officers Conference designed to review with current science and technology officers contemporary issues in science and technology and implications for U.S. policy. Science and technology officers also have the opportunity to expand their expertise by serving in exchange assign-

ments outside of the Department of State.

Significant Cooperative Science and Technology Developments:

In Fiscal Year 1989, the United States was engaged in nearly 600 bilateral science and technology agreements involving more than 20 U.S. agencies and 120 foreign countries. The U.S. contributed its support to multilateral organizations across a full range of scientific disciplines. Selected accomplishments include:

Environment

In the past year, the United States has responded to growing international concern about our global environment. At the Paris Economic Summit, President Bush joined with other heads of state in calling for urgent, decisive action to understand and protect the earth's ecological balance. The U.S. was instrumental in establishing the Intergovernmental Panel on Climate Change (IPCC) and accepted chairmanship of its Response Strategies Working Group. The U.S. was one of the first countries to announce that it would seek a world-wide phase-out of chlorofluorocarbon production and consumption by the year 2000, provided that safe substitutes are available, and we take pride as well, in progress in dealing with problems of transboundary pollution and hazardous waste. President Bush proposed legislation designed to reduce significantly emissions of sulfur dioxide and other acid rain precursors. The President also announced that he will seek legislation to ban exports of hazardous wastes from this country, except where we have an agreement with the receiving country to provide environmentally sound management of such wastes. As part of the President's Eastern European initiatives, he introduced an environmental thrust in July, 1989, consisting of two major activities:

- The U.S. and Poland initiated discussion of a plan for air and water pollution abatement in the historic city of Krakow.
- The U.S. took steps to establish an organizing committee for an in-

dependent regional environmental center in Budapest.

- On October 25, 1988, President Reagan signed a resolution designed to exert US leadership in negotiating an international convention to conserve the earth's biological diversity. Environment issues were included for the first time in the agenda of the annual US-EC Ministerial consultations.

Energy

As with environmental research, significant energy research is performed in cooperation with other nations. The Department of Energy currently has 58 bilateral cooperation research and development agreements with 27 nations, most significantly with Japan, U.K., FRG, France, Israel and Canada. In Fiscal Year 1989, an energy research and development memorandum of understanding was established, for example, between the Department of Energy and the Canadian Department of Energy, Mines and Resources.

Nuclear Energy, Nuclear and Chemical Weapon Non-Proliferation

Since the Chernobyl accident, the U.S. has been working through the International Atomic Energy Agency (IAEA) and the Nuclear Energy Agency, as well as bilaterally, to improve nuclear safety practices worldwide. The U.S., USSR, Japan, and the European Community achieved significant progress on a conceptual design for the thermonuclear experimental reactor (ITER). In Fiscal Year 1989, the U.S. and Japan continued activities under a broad program of cooperation in nuclear research. Several countries joined the U.S. in cooperation on fusion energy, radioactive waste management, and nuclear fuel development. In his speech to the U.N. General Assembly in September, 1989, President Bush announced a U.S. initiative to give additional impetus to concluding a worldwide chemical weapons (CW) ban by declaring that in the first eight years of a CW treaty, the U.S. is prepared to destroy nearly all – 98 percent – of its

CW stockpile, provided the Soviets join the ban.

Space

In Fiscal Year 1989, President Bush asked Vice President Quayle to chair a new Space Council, which is to review and develop U.S. policy. The Space Station Intergovernmental Agreement (signed on September 29, 1988) was implemented in Fiscal Year 1989. Several bilateral programs linked to the Space Shuttle Program provide the framework for payload specialists to fly aboard future shuttle flights. Twenty-nine U.S. experiments also were conducted in connection with the Soviet Cosmos 2044 biosatellite mission.

Oceans and Fisheries

In the last decade, there has been a rapid growth in the use of high seas driftnets in the Pacific Ocean. In 1989, the U.S. completed agreements with Japan, Korea, and Taiwan to control use of driftnets. A US-USSR Intergovernmental Consultative Committee on fisheries (ICC) was established pursuant to the 1988 bilateral Comprehensive Fisheries Agreement.

Polar Affairs and Marine Mammals

In November, 1988, the U.S. Government signed the Convention for the Regulation of Antarctic Mineral Resource Activities and oversaw progress toward the creation of a nongovernmental organization to coordinate Arctic scientific research and environmental protection. In 1989, the U.S. hosted the 41st annual meeting of the International Whaling Commission (IWC), at which resolutions critical of the scientific whaling of Japan, Iceland and Norway were passed.

Health and Quality of Life

Bilateral research on AIDS (Acquired Immune Deficiency Syndrome) continued between the U.S. and France, Indonesia and Japan. The U.S. Government completed phase I of the development of a model whose purpose is making projections of the international impact of AIDS. The Department of State began a study of existing and poten-

tial areas for international drug research collaboration. In Fiscal Year 1989, the U.S. also worked with specific countries on medical problems unique to certain regions of the world. With regard to population issues, United States policy continued to emphasize strong support for voluntary international family planning programs, the integration of population and economic development policies, the critical role that a market-oriented economy can play in development and in the demographic transition, and the prohibition of U.S. support for coercion or abortion in family planning programs.

Selected Large-Scale Basic Science Initiatives:

- Superconducting Super Collider: The Department of State worked closely with the Department of Energy and other agencies to develop a plan for involving other countries in the SSC initiative.
- The Human Genome Initiative is being managed by the National Center for Human Genome Research of NIH, in close collaboration with the Department of Energy. The importance, complexity, and cost of the effort to map and sequence the human genome makes international cooperation essential.

Other S&T Activities

The US-EC High-Technology Group met twice during Fiscal Year 1989. The 53-member U.N. Committee on the Peaceful Uses of Outer Space (COPOUS) continued to be active during Fiscal Year 1989. NATO's "Third Dimension," continues to sponsor the Science Fellowships, Collaborative Research Grants, Advanced Study Institute, and Advanced Research Workshop Programs. The OECD focused on cooperative activities to ensure the more effective development and utilization of technology in the promotion of economic growth, energy security, protection of the environment, and international trade. The International Atomic Energy Agency (IAEA) sponsored an international conference

on the role of nuclear power in response strategies to global warming.

Foreign Policy Implications

General Foreign Policy

International science and technology agreements often open channels of communication with important elements of society in countries where contact might otherwise be difficult. Moreover, the talents and resources of U.S. agencies may be applied to resolve crises. Joint science and technology cooperation may also be politically important. Underlying all of our S&T cooperation is the principal that international science and technology agreements are justified and funded by U.S. agencies on the basis of their individual scientific and technological merits, and the technological or scientific benefit to the funding program.

Economic Benefits

The Department of State surveyed U.S. agencies to obtain examples of specific benefits to the U.S. taxpayer of collaboration in science and technology activities. The benefits may be characterized in four general ways: 1) cost containment, 2) elimination of duplication of efforts, 3) increased pace of scientific advance, and 4) opportunities for increased trade.

National Security

U.S. national security and that of its allies can be enhanced through international cooperation on defense science and technology. Cooperative activities improve the effectiveness of U.S. defenses, improve compatibility of military forces (internationally), strengthen alliances, and efficiently utilize scarce research and development resources. The U.S. engaged in a wide variety of cooperative research and development programs funded under the Nunn Amendment. In addition, the U.S. entered into a number of new initiatives with NATO allies for defense science and technology cooperation.

Funding of Science and Technology Cooperation

Most of the U.S. federally-supported international science and technology activities are managed and funded by the individual technical agencies. In Fiscal Year 1989, the Department of State was

appropriated specific funding for science and technology cooperation with Poland and Yugoslavia.

Coordination and Oversight

Soon after assuming his position as Assistant to the President for Science and Technology, Dr. D. Allan Bromley endorsed the work of the interagency Committee on International Science, Engineering and Technology (CISET) of the Federal Coordinating Council on Science, Engineering and Technology (FCCSET), and established a new Working Group on EC92 S&T issues. In addition, a National Security Directive in early May established a Policy Coordinating Committee (PCC) of the National Security Council, chaired by the Department of State, with oversight responsibility for issues related to oceans, science, technology and environment. In response to the increasing importance of the domestic ramifications of the global change issue, a Global Change Working Group was formed under the Domestic Policy Council. This group has the lead responsibility to review, formulate, and coordinate all global change policy issues that might have an impact on the United States. The working group has Cabinet and sub-Cabinet level representation and is chaired by the Assistant to the President for Science and Technology. In compliance with the Case-Zablocki Act of 1972, as amended, the Secretary of State reported to Congress the successful negotiation of roughly 25 international science and technology agreements during Fiscal Year 1989. Oversight of the Department of State's scientific, technological, and environmental activities is achieved, in part through semi-annual meetings of the Bureau of Oceans and International Environmental and Scientific Affairs (OES) Advisory Committee. In Fiscal Year 1989, the Advisory Committee examined such issues as global climate change, the state of research into chlorofluorocarbons (CFC's) and their substitutes, and other current issues.

Management of Large-Scale Science Initiatives

The Bush Administration, like its predecessors, recognizes that international cooperation is necessary in many areas of research. The U.S. plan to collaborate with other countries to build a superconducting super collider is an outstanding example. The critically important effort to understand the processes involved in global climate change and the need to better understand the existing biological diversity of the earth and conditions for survival of species further emphasize this need. The Space Station program, on which we have agreements with Europe, Japan, and Canada is clearly such a project. Cooperation is built on extensive communication; successful cooperation requires careful prioritizing before commitments are made. The goal of detailing and understanding the human genome (and perhaps that of other species) will require this approach.

U.S Initiatives in Response to Additional Legislation and Directives: Executive Order 12591 Reference, Omnibus Trade and Competitiveness Act of 1988, Section 5171, Competitiveness Concerns:

The U.S. continues its commitment to ensuring that access to government-sponsored or government-supported programs, facilities, and science and technology information is equitable and reciprocal, and that proper consideration is given to protecting U.S. intellectual property generated by cooperative science and technology relationships.

Access

The Department of State is committed to ensuring that access to government-sponsored or government-supported programs, facilities, and science and technology information is practicable, equitable, and reciprocal, as expressed in Section 502 of the Foreign Relations Authorization Act, as amended. Cooperative science and technology agreements negotiated by the Department of State now generally include text stating that the contracting parties shall encourage and facilitate cooperation between government agencies, universities, organizations, institutions and other entities of both countries. The Assistant to

the President for Science and Technology established a Task Force on Comparable Access to R&D under the U.S./Japan Science and Technology Agreement.

Intellectual Property Rights

In Fiscal Year 1989, the U.S. intensified efforts to negotiate provisions in science and technology agreements that adequately protect and allocate rights to intellectual property furnished or produced in the course of science and technology cooperation. These IPR provisions were included in negotiations for renewal of science and technology agreements with Argentina, India, Korea, Spain, Italy, the Federal Republic of Germany, Israel, Turkey, China, Thailand, USSR, Hungary and Poland; and in proposed agreements with the Philippines, New Zealand and Indonesia. Details are provided in Chapters 1 and 3, and in Chapter 4 under activities of specific agencies.

Strategic Technology

Recognizing that the improving climate in East/West relations would result in increased interest in science and technology cooperation, the Department of State developed written procedures for interagency review of science and technology agreements and activities with Warsaw Pact countries. In addition, the Department of State organized, in 1989, its annual strategic trade officers' conference, alerting the U.S. Government international technology and trade community to the implications for collaboration.

Dissemination of S&T Information

With the successful completion of the Science and Technology Reporting Information Dissemination Enhancement (STRIDE) pilot project early in Fiscal Year 1989, it was decided to expand the project to include all Department of State science reporting officers.

RECOMMENDATIONS

(detailed in Chapter 1):

Environment: Seek collaboration in advancing an agenda to address international environmental issues of concern to the U.S.

Space: Working with the National Space Council, NASA, other government agencies and private groups, promote international cooperation where appropriate to further U.S. national interests in space.

Science and Technology: Promote U.S. science and technology interests in multilateral and bilateral fora to maintain U.S. access to foreign research and development programs; to promote the openness of research results; and to secure international support for large scale U.S. science projects, consistent with national security, economic, and other foreign policy interests.

Nuclear Energy: Reinforce the U.S. position as a reliable nuclear supplier through timely nuclear export licensing decisions and the negotiation and implementation of agreements for peaceful nuclear cooperation meeting the requirements of the Nuclear Non-Proliferation Act; attempt to restrain proliferation- sensitive countries from crossing the nuclear threshold and seek international cooperation to this end.

Oceans, Polar and Fisheries: Advance U.S. interests in management of international fisheries; promote the further study and appropriate control of high seas driftnet fishing; establish new North Pacific Salmon Organization and further to implement the U.S.-USSR Comprehensive Fisheries Agreement. Support and strengthen the U.S. worldwide navigation and general maritime position as outlined in former President Reagan's Ocean Policy Statement of March 10, 1983.

Resources: Continue efforts to incorporate science and technology expertise more effectively into the process of formulating and implementing U.S. foreign policy.

INTRODUCTION

In recent decades, the world has seen extraordinary advances in science and technology -- advances of pervasive importance to every aspect of our lives. Today, leadership in science and technology can have a profound effect on national destinies.

In many areas, the pace of scientific advancement exceeds our ability to grasp its full implications. It is clear, however, that this progress thrives on international cooperation. Free exchange of information and ideas serves not only the interests of the scientific community; it also reinforces basic principles upon which our nation was founded. Today, the breadth of scientific inquiry worldwide and the cost of these activities further exemplify the need for international collaboration.

Science and technology cannot solve all of our problems, but the potential certainly exists to alleviate wide areas of human suffering and make a better life possible for people around the world. It is, therefore, in our national interest to help developing countries achieve the level of technological progress that will hold promise for improving the quality of life for all of the world's people.

Science and technology are intimately related to the health of our global environment and preservation of our ecological heritage. With strong support of the United States, nations participating in the Paris Economic Summit in 1989 endorsed an urgent need to comprehend and respond to threats to our planet in these critical areas. At the same time, collaborative efforts during 1989 continued to address efficient use of the world's energy resources, including safe management of nuclear energy.

Improving global standards of human health are also universal aspirations and achievable only through international collaboration. The United States joins other nations in continued efforts to combat AIDS, as well as to address the range of health concerns endemic to developing regions of the world.

Most nations now recognize that science and technology are also two crucial elements of economic competitiveness -- that scientific and technological competence offers an edge in an increasingly competitive global market.

Given the significance of science and technology in the world today, America's international science and technology policy embraces the following principal themes and objectives:

A. To strengthen America's science and technology capability

1. Advance U.S. research and development objectives
2. Improve U.S. access to areas of research interest and capability worldwide by the most efficient means

B. To advance foreign policy goals

1. Improve international relations; bridge political, ideological and cultural differences
2. Advance U.S. economic competitiveness and standard of living
3. Contribute to national security
4. Help developing countries use S&T beneficially

C. Cooperate to understand and deal with global problems; coordinate in the

application of technology to issues of global concern

1. Current particular emphasis on global environmental issues
2. Other global and regional concerns -- natural hazard reduction, nuclear safety, health, etc.

To ensure the benefits of international science and technology policy in American foreign policy, the U.S. Congress reflected these themes and objectives in Title V of the Foreign Relations Authorization Act of 1979. It was the finding of the Congress that "many opportunities in diplomacy lie in scientific and technological fields," and that "the mutually beneficial applications of science and technology evidenced by U.S. participation in international agreements should be supported as important elements of U.S. foreign policy."

In order to assure effective implementation and review of international science and technology policy, the Congress established that "the Secretary of State shall have primary responsibility for coordination and oversight with respect to all international scientific and technological activities of the U.S. government...involving foreign countries, international organizations and international commissions."

The Congress acknowledged that the Secretary of State is responsible for coordination of foreign activities of the United States while the Director of the Office of Science and Technology is responsible for coordination of scientific and technological policy, plans and programs of the U.S. Government under Section 205 of Public Law 94-282. Accordingly, it is the intent of Congress that these officials work in close association in carrying out their respective statutory responsibilities.

Appropriate general knowledge of science and technology and understanding of current issues is critical to the conduct of effective international science and technology diplomacy. Congress noted, therefore, that "employees and officers of the United States should be trained in the application of science and technology to foreign policy and in international implications of science and technology developments." Furthermore, "individuals and organizations concerned with science and technology should be consulted in the formulation, implementation and evaluation of foreign policy."

Therefore, Congress authorized the addition of a small number of skilled professionals and improvement of the technological sophistication of the Foreign Service through education and training activities, and improvement in long-range planning for the application of science and technology to foreign policy problems.

Finally, Congress proposed that technological developments should be anticipated and assessed and appropriate measures implemented in ways beneficial to the United States and other nations.Effective application of science and technology to problems of international relations requires careful planning. U.S. foreign policy should, therefore, be

reviewed continually to ensure appropriate and timely application of science and technology to foreign policy.

This eleventh Annual Report to the Congress on Science, Technology and American Diplomacy serves that goal by reviewing the relationship in Fiscal Year 1989 between major issues of science and technology and U.S. foreign policy objectives.

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APPENDIX II

Invited Statement For The Record

By Rodney W. Nichols

Executive Vice President

The Rockefeller University

New York, New York 10021

for the

Hearings of the

COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY

SUBCOMMITTEE ON INTERNATIONAL SCIENTIFIC COOPERATION

U.S. HOUSE OF REPRESENTATIVES

4 April 1990

Prepared Statement Submitted for the Record By

Rodney W. Nichols

Mr. Chairman, I greatly appreciate the opportunity to submit this statement for the record. During early March I spoke with members of the committee's staff and learned how much excellent effort has gone into preparing for these important hearings. I would appear in person but a meeting of The Rockefeller University's Board of Trustees, on my calendar for many months, occurs at precisely the time scheduled for the April 4 session. My statement includes four sections:

- Core Questions: Mission and Performance
- The Circumstances: Encouraging and Timely
- General Remarks
- Answers to the Subcommittee's Questions

Core Questions: Mission and Performance

"Down-sizing" has been a corporate slogan -- and a painful activity throughout most of U.S. industry -- for most of the 1980s. Yet astute executives have seen that "right-sizing" is, in fact, the deeper approach to achieving high economic performance for the 1990s. (1) I draw upon this vocabulary to describe our goals because I believe it fits what we

must accomplish in diplomacy involving science and technology. To be sure, we should be "lean and mean" in our staffing. But each month our international relationships become more extensive and complex -- and each year technical issues become even more entwined with virtually every component of our foreign relations. Thus we need to reexamine the fundamentals, the "right size," of our international S&T mission. Until we do so, and face the consequences with respect to the resources devoted to the mission, much of the churning about coordination, analysis, and planning will simply not produce improved performance.

The Circumstances: Encouraging and Timely

I wish to note briefly a few of the reasons why the spring of 1990 is an encouraging time and a constructive context for the Congress to be holding this review.

* The White House Office of Science and Technology Policy is giving great attention to many international themes and, for the first time, OSTP has an Associate Director explicitly responsible for this subject. Not only do the principals in OSTP have broad experience in international science and technology, they also have extraordinary devotion to solving the problems raised in the Committee's questions.

* At both the State Department and the National Science Foundation, a number of senior officials are unusually well-qualified to launch the new initiatives in interagency coordination that should improve the depth and breadth of integration of science and technology into American diplomacy. Similarly, the mission agencies are supplementing their international staffs. The National Academy complex views almost every problem in global terms, and other private professional groups such as the AAAS provide platforms for international projects.

* Senior ambassadors in key posts -- such as at the United Nations and in Mexico -- have served as Assistant Secretary for State's OES. Their efforts enhance the ability of the Foreign Service to carry out the responsibilities enumerated in Title V of PL 95-426. Moreover, their competence and visibility should increase the incentives for junior officers to pay greater attention to technical subjects.

* During the past year we see welcome forthrightness about sharply increased dilemmas in assessing priorities for military and civilian foreign assistance -- and even about reorganizing the legislation and organization for AID. (2) We need robust evaluations of the large investments made by AID -- including science and technology -- and of its supervision generally by State. Our priorities in the desired S&T-driven foreign aid ought to be guided by the astute policy-setting called for in PL 95-426.

* An extraordinary number of our budding, major scientific and technological projects appear to require international collaboration and financing. There have been a few such projects in the past. Yet as the 1990s begin, virtually every field has programs that would benefit from authentic collaboration. Moreover, this is happening exactly when our resources are scarce, our alliances occasionally show signs of fraying because of economic competition, and the multilateral institutions are weak. Accordingly, the State Department will have to run fast to keep up with the ways in which scientific cooperation is essential, not merely desirable, for agencies such as NIH, the Department of Energy, EPA, and the NSF. State also must stretch to weigh the great stakes in technological diplomacy affecting agencies such as the Commerce Department, the Trade Representative, Agriculture, and Defense.

* These hearings also come at a time when the Congressional support agencies are well prepared to assist the policy analysis required to answer deeply the questions posed by the Committee for this hearing. Professional members of the staff of the Science Policy Division in the Congressional Research Service were pioneers in work that led to the Title V; the late Franklin Huddle was an inspiration to many of us who have followed these issues from the 1960s to the present. (3) The CRS's Genevieve Knezo remains one of the most cited members of the small group of scholars in this area. At the Office of Technology Assessment, many studies have an appropriately strong international perspective. The Con-

gressional Budget Office and the General Accounting Office also have expert staffs with pertinent capabilities.

* Finally, the private sector apparently cares a great deal more about these issues than it did, say, a decade or two ago. Business and universities are more international enterprises in terms of people, products, services, cash, every measure. I am also proud to bring to your attention that the Carnegie Commission on Science, Technology and Government -- a private and non-partisan 5-year effort -- has given an especially high priority to the international topics. Attachments give a summary of the Carnegie Commission's international program along with short accounts of three ongoing tasks. The Committee's staff will participate in the June 1990 workshop that will examine many of the issues being explored at today's hearing.

I have not mentioned crucial substantive choices about economic competitiveness, population growth, energy, non-proliferation of nuclear weapons, environmental issues, strategic and conventional arms control, immigration of students and skilled professionals, the AIDS epidemic, the revolution in biotechnology for applications in health and agriculture, and telecommunications. Such subjects merit great attention, of course; but they are not at the center of hearings designed to enhance the process and capabilities for dealing with them.

General Remarks

To begin with, I believe Title V of PL 95-426 is wise policy. Indeed, ever since this legislation was passed, I have felt that it provided an excellent framework for thinking about how we should proceed to coordinate science and technology in foreign policy. In various ways I have been a constructive critic of the State Department's performance, cheering on the officials who made significant improvements.

One example of the State Department's leadership was Secretary George Shultz's cable to all missions in 1984, in which he said that "Foreign policy decisions in today's high technology world are driven by science and technology." (4) Along similar lines, Secretary James Baker earlier this year, in a speech largely about environmental problems, underscored broader lines of the relationship between science and diplomacy by emphasizing scientifically informed "sustainable development" and, in particular, the "serious scientific research that is critical to any responsible approach" to global environmental threats. (5) Plainly, the Secretaries know our foreign relations confront the imperative of pursuing the objectives of Title V.

Doing this well has been difficult. As I said earlier, a key problem is to define in detail the S&T mission of the State Department. Unfortunately, it is easier to define what the State Department should not

try to do than to define its main tasks and positive comparative advantages. In testimony I gave in 1983, I pointed out that "it is not reasonable to see OES as either the principal source of initiatives or the only responsible manager of international science and technology policy." (6) During correspondence with a recently retired and very senior foreign service officer, I have been exploring how best to define what the State Department should do. It is more puzzling than may be obvious, partly because of the strengths in the large mission agencies and partly because the Department frequently sends most of its senior, technically savvy officials to ongoing negotiations. By and large, these officials conduct the negotiations with remarkable ability, even prescience. But there are few OES officials in Washington left to take care of imminent policy issues, much less longer range ones.

So I suggest that the Committee consider asking, in effect, for a detailed "job description" for OES. This is no mere bureaucratic exercise. At bottom we are talking about how to relate technical knowledge to political, military, and economic power. Kissinger and Brzezinski touched this subject in 1988 essays from the Library of Congress. Kissinger noted that "effective foreign policy is impossible without (knowledge), yet the temptation to wait for perfect or nearly perfect knowledge before acting can bring national paralysis and even catastrophe." Brzezinski probed why it has been such a challenge for Americans and their Presidents to "translate knowledge into power in the diplomatic

realm in order to create something akin to a strategy." (7) Defense and intelligence -- the key concerns of national security -- clearly depend upon technological choices. But what about the other international links? Which organization will distill the technocratic insights for diplomacy at the highest level?

The next most critical problem is resources. Question # 4 from the subcommittee concerns resources. But there has not been nearly enough discussion about exactly why the Department has been so starved -- it is virtually a case of anorexia nervosa -- with respect to both funding and staff. Not only does the United States have an extremely small cadre of scientific attaches and counselors within the State Department, but there also is virtually no funding for travel, for advisory committees, for back-up research and analysis. When it comes to training -- one of the key and explicit requirements of Title V (paragraph 2656B (3)) -- I was informed that OES has a grand total of $6,000 for training. Does the State Department ask the OMB for the resources required to fulfill Title V? If so, does OMB help the State Department make a case to the President? Would the Congress be sympathetic to requests for additional appropriations to the State Department for these Congressionally mandated tasks? We cannot fulfill the requirements of Title V on the cheap.

Other questions focus on organization across the top of the State Department itself. Science and technology should enter into the daily

activities of the Economics Bureau, the Bureau of Intelligence and Research, the Policy Planning staff, and the regional bureaus. These topics should be an integral part of the highest level staff work for senior officials. Yet OES is not in a position to carry out all of these functions, and science and technology do not graft easily onto the traditions of the Foreign Service. Do we wish to break up OES so that, for example, the enormous new surge of important environmental topics might be split out into a separate bureau? Instead, do we wish to gather together more S&T resources into a strengthened OES that would work even more closely with the Undersecretary for Science and Technology and Security Assistance and/or the Undersecretary for Management? At which level and in which domains will it be most likely that science and technology can help with both the fire-fighting and the longer range reconnaissance that are needed?

Finally, in these opening remarks, I must mention the Advisory Committee to OES. I've been a member of the Committee for many years and worked with a number of the very able leaders of the OES Bureau. Unfortunately, largely because of limited resources, the Committee meets only about twice a year for half a day at each session. There is little continuity in the topics considered, little staff support, no reimbursement for travel, and only fleeting contacts with the most senior officials. With President Bush's leadership in reestablishing a President's Council on Science and Technology, I should hope that the State Department will

follow suit and lift both the priority and the resources for this OES Committee so that it could play a role comparable to those of a number of other senior advisory groups to the Executive Branch and to the Congress.

* * * * * * * * * * * * *

Answers to the Subcommittee's Questions

1. How has the world changed since the enactment of PL 95-426 (the Foreign Relations Authorization Act of 1979), which lays out goals and procedures with respect to the conduct of international science and technology policy? For example, does the democratization of Eastern Europe and Latin America create new opportunities in science and technology cooperation? Are changes needed in the law to respond to these and other trends?

As I have indicated earlier, although the world surely has changed since PL 95-426 was passed, the basic thrust of the legislation remains valid. Indeed, the legislation is perhaps even more important today. New opportunities grow up for cooperation in science and technology. Greater complexity arises in the integration of science and technology into our foreign policy goals, instruments, tactics and strategies. None of these changes -- nor all of of them together -- argues for a different vision than that in the law.

2. How effectively has the U.S. used science and technology as a foreign policy tool? Should there be increasing or decreasing emphasis on the use of science and technology in this context?

Our record is mixed, but mostly good. In health, defense and agriculture, for example, we have fulfilled national purposes and served global demands for applying our hard-earned technical prowess. Still, I have some regret in regarding science and technology as "a foreign policy tool." These "assets" have been used that way, and their value as "chips" -- especially in civilian fields -- no doubt will continue to increase. But the more demanding task is perceptive integration of our scientific and technological resources into diplomacy; that will be more like an architect achieving a better blend of function with beauty than a carpenter using a tool with greater craftmanship.

3. The Department of State is designated by PL 95-426 as the lead agency with respect to the application of science and technology to foreign policy. How effectively has the Department fulfilled this role? Is DoS actually in the lead -- that is, what are the roles of the Office of Science and Technology Policy, Department of Commerce, the U.S. Trade Representative, Department of Defense and others in this process?

The State Department has not always been an effective lead agency. Often, the depth and verve have come from other parts of the Executive Branch or from the Congress. Recent OSTP leadership has promised to renew FCCSET operations -- with State playing a strong role in the international cross-cutting domain. The State Department has extraordinary

abilities for crucial roles that always are at the intersection of (a) the skills in technically based mission agencies with (b) the political and economic purposes of our government's dealings with both the international private sector and other governments. Frequently, the mission agencies perform erratically in international affairs; various cases reveal problems in the exploratory stages of projects, or in negotiations, or in planning for the interfaces of technical change with international politics.

4. Is there a planning and review process for international science and technology policy in the Department of State? Are there sufficient resources to carry out such planning and review? Does the annual Title V report to Congress serve a useful role in planning and review?

Earlier I emphasized that there are not sufficient resources available to the Department of State to carry out its assignments in planning and review for international science and technology policy. The Title V report has received decidedly mixed reactions. Frequently, it has lacked continuity, depth, timeliness, analytical subtlety, and candor. Many practical variations could be devised to improve this reporting process and to make it more helpful as a discipline within the Executive Branch and as a framework for the Congress to debate.

5. What is the Administration's policy on foreign participation in big science initiatives? Why has foreign participation been handled differently in the following cases: Space Station, Earth Observing Systems (EOS), Human Genome Project, and the Superconducting Supercollider (SCC)?

Evidently, most "big science initiatives" have been handled in an ad hoc way. In truth, many of these projects may founder on our ambivalence about either financing them alone so as to gain (or regain) leadership -- or entering into a more cooperative partnership in which the U.S. would not necessarily be "the leader." It is hardly fair to blame the State Department for this national uncertainty about whether we can afford what we would prefer. Citizens, scientists, politicians, and officials throughout the government experience this ambivalence.

6. Should all areas of science and technology come under one policy "umbrella"? Or, for example, should there be distinct policies for science and technology that benefit the environment, or that advance U.S. competitiveness?

I believe it is impossible to have a single such "umbrella." In the example given, the U.S. clearly will have to consider together a bundle of issues about the environment, economics, and energy. Developing countries must do this, too. Incidentally, a forthcoming Carnegie Commission report assesses how best to organize to accomplish this task of E3 (Energy, Economics, and Environment). Some broad principles can be set -- or restated -- to guide policy for civilian, international S&T. These would include ideas about human rights, communications, travel, property rights, and assurances of reliability and reciprocity. Debating these, and then consistently applying them to many projects, would be helpful.

7. Would it make sense to have different policies and objectives for international "science agreements" and international "technology agreements"?

If the metric is scale -- dollars or persons, with "science" typically smaller scale -- such differentiated policies may work. But the lines are fuzzy, indeed. For instance, training a few young scientists in molecular biology may produce the embryonic capacity for large-scale, world-class biotechnology. Along other lines, technological assessments in the future may be done best internationally, with technological implementation done locally; hence, for example, a renewed case can be made for supporting IIASA and eschewing multiple bilateral exchanges. "Big- time science," in any case, usually is at the core of large-scale technological enterprises. Thus, agreements of any significance must keep an eye on the whole board.

8. What is the role of intellectual property rights (IPR) in the negotiation of science and technology agreements? Do IPR function as an opportunity or as an impediment to the advancement of foreign policy goals?

I am not an expert on the myriad ways in which this contentious subject arises. From my personal experience, IPR have been an impediment in certain negotiations between U.S. private firms and universities dealing with foreign governments. In principle, however, IPR can be an incentive in our "foreign (economic) policy." Surely we can continue to advance U.S. open market traditions without jeopardizing foreign policy goals -- and more effectively during the 1990s than in some earlier times.

Permit me to close with an excerpt from a 1988 speech at Bilderberg by Walter Wriston:

> The fact that politicians and diplomats are by nature attracted to political historians who record the rise and fall of nation states, but generally display little interest in the history of science, contributes to the problems of understanding what is happening. Indeed, many renowned history books barely mention the impact of science on the course of events. In ancient Greece, Plato explained that even in his time, engineers were not held in high regard by philosophers: "You despise him and his art," he wrote, "and sneeringly call him an engine-maker, and you will not allow your daughter to marry his son or marry your son to his daughter." Nothing much has changed, even though scientific events are altering the shape of national and international events in fundamental ways. (8)

Satellites, ozone holes, smuggled computers, designed materials, malaria vaccines, instant information, capital transfers by wire, and a genetically engineered agricultural revolution -- these are the developments that diplomats must grasp. Technological change compels planning. Diplomatic achievements can flow from our R&D strengths.

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Notes and References

1. See feature articles in Fortune, April 9, 1990

2. See, for example, the "Woods Report" from AID: Development and the National Interest: U.S. Economic Assistance into the 21st Century, February 1989; and the report of the Task Force on Foreign Assistance, House Committee on Foreign Affairs, Document 101-32, February 1989.

3. Technical Information for Congress, Committee on Science and Astronautics, April 25, 1969, revised April 15, 1971.

4. Cited in "Science and Two-armed Diplomats," Rodney W. Nichols, Science, 12 October 1984.

5. Address to National Governors Association, Washington, D.C., February 26, 1990.

6. Testimony before Committee on Foreign Affairs, August 3, 1983.

7. Knowledge and Power, Symposium by Council of Scholars, Library of Congress, June 15-16, 1988.

8. Walter B. Wriston, Mimeo, Bilderberg, Telfs-buchen, Austria, June 3, 1988.

STATEMENT

WILLIAM A. NIERENBERG
DIRECTOR EMERITUS, SCRIPPS INSTITUTION OF OCEANOGRAPHY
UNIVERSITY OF CALIFORNIA, SAN DIEGO
LA JOLLA, CALIFORNIA

HOUSE COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES
WASHINGTON D.C.

APRIL 4, 1990

I. Introduction

My name is William A. Nierenberg and I have had almost exactly thirty years of experience and practice in international scientific and technological matters. For two years, 1960-1962, I was a Foreign Service Reserve Officer I in the Department of State acting as Assistant Secretary General of NATO for Scientific Affairs. I was on leave as professor of nuclear physics at the University of California at Berkeley and the Lawrence Radiation Laboratory.

Since then, I have been advisor at large to the science officer of the State Department followed by being a member of the OES Advisory Committee. As a recent member of the National Science Board, I was chairman of its committee on international scientific affairs.

As director of the Scripps Institution of Oceanography for twenty-six years I have been involved with a large variety of research programs all over the world at all latitudes and all longitudes and on land as well as at sea.

II. GENERAL COMMENTS

In these preliminary paragraphs I try to make a few general observations that I hope will make clear the basis of some of my responses to the seven questions that have been put forward for todays discussion.

The first is the health and status of US science. My primary source is the serica, Science Indicators, biennially produced for almost the last twenty years by the National Science Board, originally as a part of a series of annual reports mandated by the Congress and since continued because of its obviously great value. As an aside, this publication is viewed by foreign countries as a guide for program development in science. Mainland China translates this document and distributes it widely. To summarize the twenty years extremely briefly and only with respect to the quality of basic science research in the US, I make the following observation. In the very early editions and, on the basis of the best available polling techniques, the conclusion was drawn that the US led in all the basic areas of research except molecular biology and biochemistry. The UK was slightly ahead in the first and West Germany the same in the second. Since then the US has maintained broad leadership in all

fields. A previous President's Science Advisor once remarked that it is not essential for the US to be first in all areas of science. He is probably correct but the fact is that we are.

To gain more insight, our NSB committee polled the science structure of the Federal Government to discover relative weaknesses in subfields of the major divisions of basic science. Remarkably few showed up. As far as I can determine, US science is not only holding its own but is opening its lead. There are many other indicators such as the groupings of other advanced nations to attempt to match us in fields like astronomy and particle physics or the formation of unions like Eureka is an attempt to maintain some degree of parity. I know that this evaluation is not in accord with frequently stated opinions but I believe it is factual. Concern about our losing our lead particularly because of statements about the comparative weakness of US science education has been widely advertised for twenty-five years but we stand today stronger than ever and failure to recognize this fact can lead us into taking wrong actions in many directions and particularly in the area of foreign affairs that we discuss today.

A second observation is the tremendous breadth of the sciences that we must consider of which major portions are very often overlooked in these analyses. Because of concentration on leadership in high technology we think mostly of computers and computer chips, biochemical engineering, space technology and in prestige areas we concentrate on particle physics and astronomy. Yet our strength lies across the board to sciences like forestry and herpetology, anthropology and archeology as well as to the aforementioned sciences that seem to monopolize media attention. Our agricultural scientists have performed and still perform miracles. While we correctly go international in our concerns about global warming we ignore the increase in acreage production of corn that has gone at the rate of two per cent per year for many years and will continue for a long while. We concern ourselves with the northward migration of crops under the influence of global warming without noting that varieties of corn are being developed that move the northward boundary of cultivation at a steady rate and it is being grown in Canada today. We cannot discuss our involvement in international science without properly appreciating the strength and breadth of our own infrastructure.

A third point I want to make is the general nature of our interactions with other countries in scientific affairs. This I categorize bimodally -- the developed countries and the lesser developed ones. The questions posed for today's hearings implicitly concern themselves with actions of the federal government. Yet, for many years, both before and after WWII, the overwhelming interactions between the American scientific community and those of the European nations has been largely independent of governments. For the longest time it was based on university sabbatical leaves and international scientific meetings and, in more recent years, it has been fostered by the exchanges inherent in the formation of the multinational technical companies. While the government's role has become increasingly important in financing travel and support for these exchanges, the direct government contribution has been minuscule compared to this interaction, particularly when the student exchanges are taken into account. The large fraction of scientific and engineering graduate students in our country today is both viewed with alarm as eventual competition and praised as a potential contribution to our pool of brainpower.

The LCD's present a totally different aspect. They have little to offer in direct exchange in the basic sciences and our efforts in this direction traditionally have been to help

them develop in the sciences, especially those that have a more immediate and direct benefit to their development. AID has been the principal vehicle in this mode and, while the quality of science that AID delivers has been the subject of criticism by some, it is our only substantial conduit for support, except for the contributions of private foundations in specific areas. A problem has arisen in recent years, however, that has not been adequately addressed. Our field scientists have frequently found it difficult to pursue their researches in many of these countries despite the substantial aid, both scientific and material, that we have delivered. The permit system for conducting archeological or anthropological work, for example, has gone to the highest bidder despite the overwhelmingly larger support regularly given by our government. Mainland China is an example of such an anomaly. We should have a better coordinated diplomacy supporting overall US science. The LDC's pose a more difficult and delicate diplomatic problem with respect to global environmental issues and the related sciences. By definition, the LDC's figure heavily in such questions as the preservation of species and biodiversity as well as the global warming issue via deforestation. Bringing the US scientific might to bear on these grave problems is more than just fostering scientific exchange. It raises a host of political and economic issues that exceed the normal role of the scientist.

I cannot be as coherent as I would like to be in this section. Having mentioned global warming twice I feel compelled to draw attention to the lack of appreciation of the rest of the world with respect to the US contribution to the study of global environmental change. In the case of global warming, the US scientific budget is considerably more than that of the rest of the world combined and soon will be even more. An unnamed advanced country can announce an enhancement of effort of one twentieth of that of the US and the international meeting bursts into applause but remains silent with respect to our enormous effort. It is taken for granted.

A fourth issue that is not directly addressed is that involving international organizations like UNESCO, WMO, WHO, UNEP and the IOC. While UNESCO has presented problems that the Administration and the Congress have so far been unable to resolve, the others have been very successful in carrying out their designated roles. The UNESCO problem is accentuated by the clear fact that there is no significant cross section of working US scientists involved in its operations. Their time is absorbed elsewhere, in the mission focussed agencies or in Washington, DC, where the real action is. The vast majority of US scientists have little to do with UNESCO and so the political support for our adherence does not have the broad base of support from the community that a specialized agency draws from its benefitted participants.

III. RESPONSE TO QUESTIONS

I respond to questions one and two as a unit. From what I have said earlier, the national effort in science is so broad and so deep and, since virtually all have international aspects, it is not easy to respond in simple terms. The National Academy of Sciences, along with its fellow institutions, the National Academy of Engineering and the Institute of Medicine, has as broad a representation in the sciences as could be expected and yet fails in completeness. The academy has tried, from time to time to evaluate US science across the board. It has available a panoply of the best scientists in all the fields (who serve without fee). Even so, and over the course of several years, the list of reviewed field is incomplete. Even

allowing for the restriction of international pertinence, the complete task, as outlined in P.L. 95-426, is unrealistic and is beyond the State Department's capabilities as they exist.

To further complicate the issue, there are at least thirty country to country agreements that have to be serviced, renewed and otherwise worried over. These agreements have often been initiated not by scientific considerations or possible scientific benefit to the US but rather as a palliative to an otherwise unexciting heads of state meeting. This does not necessarily mean that they are all unproductive but the procedure is certainly hit or miss. Fortunately, the Department has other agencies, especially the NSF, to turn to for help in monitoring these operations.

To respond to the question as to how well the State Department is carrying out its role, the answer is almost obvious. Within the limitations I describe above, the Department's performance has been variable. In some instances, where personnel has been suited to the problem and the interagency cooperation has been forthcoming, results have been good. In other cases, the favorable situation did not exist and, hence, neither did results. I have to amend that comment by pointing out that there are some countries, that I do not name here, with whom cooperation is impossible no matter how much they want our technology. They have an ideological (perhaps mental) block at the official level against their carrying out their part of an agreement on their soil or near their territorial waters. The State Department has been forced by external circumstances to enter into unworkable agreements with these countries even though their experience has taught them to shun such unprofitable relationships.

As to question three, I limit myself to advice I have offered in the past. Since I feel that the State Department cannot carry out its mandate without a structure similar to that of the Academy or some fiat to be able to exercise control over other agencies to a degree that has never heretofore been possible in our (or any) government, a sense of priorities should be established along with certain advisory and representational arrangements. The science officers in the department should concentrate on those areas of science and technology that are likely to emerge as major international issues in the intermediate future, say the next ten years. This is not a crystal ball affair, there is plenty written in the scientific literature to guide in the selection.

Good examples have been global warming, acid rain and the ozone layer depletion question. The department has done very well at the working level, over the years, in keeping up with these questions and maintaining good contact with the relevant scientific community. As a result they were up and running when the question inevitably reached the international diplomatic arena. The working level would be more effective if the upper levels of the department were more sensitive to these scientific issues.

Another recommendation I have made is for better and more advisory boards on substantive issues. Relying on interagency committees does not guarantee the best scientific advice in a country like the US where the science infrastructure is so complete and available. The OES Advisory committee is an important and useful body but it cannot take the place of smaller bodies that can advise on specific issues or act as backup for delegations that monitor bilateral agreements. A good model is one that the NASA Advisory Council used. The NASA Advisory Council is, in effect, the senior council. There are substantive subcommittees for the

technical fields of interest of the moment. The chairmen of these subcommittees are, ex officio, members of the senior council.

There is one further point. As I have indicated earlier, there are perhaps of the order of thirty bilateral agreements in operation. There are regular exchanges between the countries involved. I have recommended that the US be represented on each of these occasions by scientists of distinction in the disciplines involved. This is not presently the case. This procedure would assure our partner of the seriousness of our intentions and make for a better liaison with the US scientific community which is rarely the situation today. It should be evident that I place great importance on the intimate connection with the relevant part of the US technical community.

The fourth question on the "incoherent ... " collaboration of the US with other countries is an interesting one that has, in itself no coherent answer. First, the scientific disciplines vary considerably. Maintaining herbaria and geological surveys require different approaches, different protocols and result in different diplomatic interventions. Intercomparison of agreements might suggest incoherency. What is incoherency of greater concern is the variability in the return to the US. Different criteria seem to be applied in different situations to the point where some arrangements end up with little benefit to the US and much unrewarded effort expended by the small number of officials presently involved.

My answer to question five is a simple "yes", it would make sense.

I do not clearly understand the implication of the thesis of the cited article. It is certain that the recent US hard line on property rights has hindered and slowed down completion of bilateral agreements. It is not nearly as certain that it has had a substantial negative affect on US science and technology. I would say that the second country has far more to lose in the delay or failure to conclude an agreement.

In response to the last question, I do not believe that the US has been missing opportunities for international cooperation and burden sharing. There have been some notable successes like the National Science Foundation's Deep Sea Drilling Project where there are reasons beyond financial for broad international participation. However, there are open questions involving the SSC and a number of astronomy projects where the there has been surprisingly little discussion but where opportunities do exist.

IV. RECAPITULATION

As should be readily inferred from my responses, my thinking is heavily influenced by the eminent position of the US in the scientific world and its steady rate of improvement. Scientific information pours into our laboratories and schools at a great rate from workers who are anxious to have their results recognized here and there is a steady influx of researchers desirous of availing themselves of the better research climate and possibilities in the US. A striking recent development is the action of the Pasteur Institute in Paris in converting their major publications into English.

Where research is handicapped is where it has a geographical locale that requires governmental permission for access as in biodiversity, climate, anthropology, geology,

archeology and oceanography, for example. We can do better in using our dominant position in the sciences towards facilitating exchanges in these and similar areas.

A bolder approach, beyond the objectives of the present discussion, would be the development of a geotechnopolitique where we use our potential technological strength to influence the course of world events in our favor. A good example could have been made at the time of the oil crisis and oil embargo in the early seventies. This happened not too long after R/V GLOMAR CHALLENGER retrieved a core containing oil from the Sigsbee Knolls on its first research leg. Given the known marine geology of that part of the Gulf of Mexico, the existence of a fair number of major oil fields could be inferred. Subsurface completion and related technologies made feasible the concept of retrieval of this oil, even at its depth of ten thousand feet, although probably above the economics of the time. Still a modest investment in a vigorous, open campaign of exploration and delineation of the extent of these findings would have had a profound effect on the thinking of the OPEC nations without having to go to the extreme of production. When the news broke about the US Navy retrieving the Russian submarine from the deep Pacific, my Russian colleagues, who were familiar with the related technology employed by GLOMAR CHALLENGER, told me that they were not surprised. It was just what they expected of US technical prowess.

These are objectives more far reaching than any implied in P.L. 95-426 and probably cannot be achieved by law. It requires a sense of the power and possibilities of American science and technology at the levels of the Domestic and Security Councils that does not exist at present. Part of the blame lies with the scientific community itself. Their leaders have consistently underestimated the pace and extent of developments in their own fields.

I conclude with a well known but controversial example of geotechnopolitical pressure. That is the Strategic Defense Initiative. There has never been any real question of the ability of American science and technology to meet the objectives of the program even from the most vocal of informed critics. The point is that the Russians believed that it could be done and that was evidenced by the vigor of their campaign against the initiative. More important, many believe that it was a major factor in bringing them back to the disarmament table. The ultimate cost may be low for it seems certain that the system will never be built according to the original concepts but a major objective yet has been achieved.

March 26, 1990

APPENDIX III

Herman Pollack
3517 Tarkington Lane
Silver Spring, MD 20906

June 1, 1990

Mr. Ralph M. Hall, Chairman
Subcommittee on International
Scientific Cooperation
Committee on Science, Space and Technology
U.S. House of Representatives
Suite 3221 Rayburn HOB
Washington D. C. 20515

Dear Mr. Chairman:

I regret missing the deadline for the return of the testimony. Unfortunately, it was sent to my office at the University rather than to my home address. The testimony was forwarded to me and just received. My corrections are very minor.

You did pose one question to me, namely whether PCST and FCCSET/CISET are workable solutions to the projection of special interests in negotiation of S & T agreements rather than overall national interests.

I have had no personal relationships with either of these committees although I knew their predecessors very well and was a member of the predecessor of FCCSET. Unless some historic change has taken place in bureaucratic and human behavior the current FCCSET is a collection of special agency interests, as was its predecessors and is given to compromise and balancing of views which would only accidentally equate with national interests. Inter-agency committees are a tried, true and effective mechanism for transacting government business in areas of interest to more than one committee. However, committee members represent their agencies and usually proceed in deliberation from parochial agency positions. The product of an interagency committee is never free of the political content brought to it by its members.

PCST, like its predecessors probably consciously seeks to view its agenda from the Presidential perspective.Its recommendations probably do seek to reflect national interests. However, PCST does not concern itself with individual agreements for cooperation, nor should it else it become bogged down in these and similar subjects.

Sincerely,

Herman Pollack

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Republican Chief of Staff

May 16, 1990

Mr. James O'Connell
Director, International Trade and Policy Affairs
Control Data Corporation
Suite 370
1201 Pennsylvania Avenue, N.W.
Washington, DC 20004

Dear Mr. O'Connell:

On behalf of the Subcommittee on International Scientific Cooperation, thank you for your April 4 testimony on International Science and Technology and U.S. Foreign Policy. Your testimony -- and your perspective as a representative of a U.S. corporation -- will be very useful to the Science and Foreign Affairs committees as they weigh legislative options in this critical area of science and technology policy.

Enclosed is a copy of the recorder's transcript of your oral testimony. Please review the transcript for accuracy and return it to the Subcommittee according to the attached instructions. Please be advised that under Committee rules, testimony is published in strictly verbatim form. Only typographical and transcriptional corrections may be made at this time.

We have some follow-up questions which are important to fully understanding the issues surrounding international science and technology and foreign policy. A response within two weeks will allow your reply to the following questions to be entered in the record:

1. One of the witnesses, Dr. Gomory of the Sloan Foundation, stated that "Absences from the home turf [to spend time in a foreign scientific or technological institution] are not regarded as good for one's career."

   a) Does this statement apply to the corporate environment to the same degree as it applies to government and the universities?

   b) Should the U.S. government play a role in encouraging U.S.-based corporations to send employees abroad to take advantage of U.S. access to foreign facilities?

2. How can U.S. government and U.S. industry be better partners in gaining access to and taking full advantage of equitable flows of foreign technology into the U.S.?

   a) Should the U.S. government play an increased role in industry's efforts to acquire specific technology from abroad?

   b) Should government play a role in ensuring that U.S. industry does not "give away too much" technology to foreign interests?

Again, we very much appreciate your time and interest in participating in this hearing. If you have any questions, do not hesitate to contact Dr. Robert Palmer, Dr. Barbara Frank, or Mr. Paul Denn on 202/226-3636.

Sincerely,

Ralph M. Hall

RALPH M. HALL, Chairman
Subcommittee on International
Scientific Cooperation

PD/ls

Rec'd 6/4

CONTROL DATA

1201 Pennsylvania Avenue, N.W.
Suite 370
Washington, D.C. 20004

May 29, 1990

The Honorable Ralph M. Hall
Chairman
Subcommittee on International Scientific Cooperation
Committee on Science, Space and Technology
U.S. House of Representatives
2321 Rayburn House Office Building
Washington, D.C. 20515

Dear Mr. Chairman:

This is in response to your letter of May 16 concerning my testimony of April 4. It was a great privilege and high honor to be invited to testify before your Subcommittee, and I am delighted to provide the following answers to the follow-up questions.

1. (a) I do not believe the statement applies to the corporate environment. As international trade comes to account for a more significant portion of companies' annual revenue, over fifty percent for some firms already, time spent in foreign subsidiaries will increasingly be regarded as essential to advancement. Indeed, many American companies are now assigning their executives to foreign subsidiaries on a temporary basis to acquire more experience in international operations.

(b) I cannot envision a role for the U.S. Government in encouraging U.S.-based corporations to send employees abroad.

2. As outlined in my testimony, the U.S. Government and U.S. industry must become better partners in gaining access to and taking full advantage of equitable flows of technology.

(a) The U.S. Government must play an increased and catalytic role in industry's efforts to acquire technology. I have indicated some suggestions in the prepared text, and these include--identifying technology cooperation projects; initiating preliminary contacts with foreign companies and research institutes; outreach to U.S. companies, including small business, to encourage interest in the acquisition of such technologies; and otherwise to be the facilitator of international cooperation in science and technology.

The main point is that government must be pro-active in promoting international technological cooperation. Government cannot simply negotiate agreements with boilerplate texts. Federal agencies must implement such agreements in ways that foster increased international cooperation and equitable access. In short, the U.S. Government must be the "bridge" between U.S. business and foreign governments in strengthening international cooperation in science and technology.

Control Data also suggests that the Committee authorize annual measurement of international flows of technology. American policymakers must have better data on this critical precursor of goods and services trade flows.

Thank you again for the opportunity to share our thoughts on this vital subject. Control Data commends you, Mr. Chairman, and the professional staff of the Subcommittee, for organizing and conducting this important hearing. We would be delighted to be of assistance to the Subcommittee at any time in the future.

Sincerely,

James J. O'Connell
Director
International Trade Policy

OAK RIDGE NATIONAL LABORATORY
OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE U. S. DEPARTMENT OF ENERGY
ALVIN W. TRIVELPIECE
VICE PRESIDENT, MARTIN MARIETTA ENERGY SYSTEMS
DIRECTOR, OAK RIDGE NATIONAL LABORATORY

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831-6256
(615) 576-2603

June 20, 1990

The Honorable Ralph M. Hall
Chairman, Subcommittee on International Scientific Cooperation
Committee on Science, Space, and Technology
U. S. House of Representatives
Suite 2321 Rayburn House Office Building
Washington, D.C. 20515

Dear Mr. Hall:

I received the transcript of my testimony enclosed in your letter of May 16, 1990, and am returning it to you with several minor revisions. My reply to the questions raised by the Subcommittee accompanies this letter. Thank you for allowing me the privilege to participate in discussions with the Subcommittee on International Scientific Cooperation.

Sincerely,

Alvin W. Trivelpiece

AWT:jl

Enclosure

RESPONSE TO THE SUBCOMMITTEE'S QUESTIONS

Question 1: From your experience at Oak Ridge, how successful have the following federal programs for technical information dissemination been: (a) Japan Technical Literature Program; (b) STRIDE (Science and Technology Reporting and Information Dissemination Enhancement) Program?

Oak Ridge National Laboratory has many contacts with the Japanese research community. Interactions with Japan are in such areas as nuclear reactor technology, magnetic fusion, reprocessing of nuclear fuel, materials science, and metallurgy. Our interest in Japanese research in these areas is significant and we are supportive of efforts to access information products in a more timely manner. When the Technical Literature Program began, the program's progress was hindered by the paperwork required to access communications links supporting the program. As commercial information services expanded to increase coverage of Japan, a more satisfactory situation resulted in the availability of extensive English language translations of abstracts of the Japanese scientific and technical literature. Coverage with commercial services has expanded to now include newsletters on science and technology, the economy, and engineering patents. It is clear that substantial progress in this area quickened when it was targeted through legislation.

Although the initial phase of the STRIDE program limited areas of interest to superconductivity, microelectronics, and structural ceramics, I understand that these areas proved the feasibility of the program. ORNL participated in this program through the Department of Energy's Superconductivity Information System. This provided our research community with knowledge of worldwide publications and research directions for high temperature superconductivity. ORNL is also part of the next phase of STRIDE's development with the National Science Foundation's Science and Technology Information System. It is important that electronic access be combined with software to allow efficient retrieval of relevant reports. Timely electronic delivery of the full text will not only reduce lags in disseminating this valuable product, but will also enhance the capability within organizations for internal redistribution. Progress in establishing effective mechanisms like these is important if the United States expects to compete effectively worldwide.

I recently received the General Accounting Office report, **Foreign Technology: U.S. Monitoring and Dissemination of the Results of Foreign Research** (report GAO/NSIAD-90-117, March 1990). It provides additional information on both the STRIDE and Japan Technical Literature programs as well as other programs of United States government agencies.

As with any new scientific information product, significant efforts need to be made to promote these products to scientific and technical communities, in the federal laboratories, universities, and the private sector. Meetings of professional societies and journal articles can be effective vehicles to develop a clientele and to prove the value of these programs. I strongly encourage efforts to disseminate information about foreign research throughout the U.S. scientific community, but realize that restrictions concerning classification, copyright, and proprietary information need to be considered in establishing access to computer networks.

Question 2: On page 12 of your testimony you state, "efforts to prevent the flow of technology from the United States have probably resulted in the prevention of agreements and exchanges that would have benefitted the United States and other countries." (a)

Please provide one or two specific examples of S&T agreements or programs in which benefits to the U.S. could be enhanced by liberalizing U.S. technology transfer restrictions. (b) Do you believe policy or regulatory changes are necessary to allow greater freedom in the flow of technology?

The Aspen Institute seminar mentioned in my April 4, 1990, testimony, in which I participated, discussed U.S. policy on international technology transfer. This conference supplemented the 1987 National Academy of Sciences panel on The Impact of National Security Controls on International Technology Transfer. The NAS panel called for a balance in United States policy regarding military defense, U.S. competitiveness, and the viability of our international alliances.

It is difficult to identify a particular program where competitiveness has been the dominant issue. According to an article in **The New York Times**, June 14, 1990, the Secretary of the Department of Commerce has recently discussed the new CoCom export control policy before the Republican House Task Force on Competitiveness. He is reported to have said that selling telecommunications equipment, computers, and machine tools to Hungary, Poland, and Czechoslovakia was worth the the risk of advanced technology slipping into the Soviet Union. Because technology has a finite lifetime in which it is a valued commodity, it is important that a balance be maintained among security and economic issues. This can be summarized in a statement from the Aspen Institute seminar: "Export controls cannot be seen only as a way to deny military adversaries the privilege of importing critical technologies; the costs to U.S. competitiveness must also be counted."

At the June Washington summit, President Bush and President Gorbachev signed protocols dealing with the peaceful uses of atomic energy. Free scientific interchange, such as that encouraged in those agreements, works to the advantage of both parties. Regulatory changes are not necessary to balance export controls with competitiveness.

Question 3: In your testimony you strongly support increased funding levels for S&T cooperation within SEED (the Support for East European Democracy Act of 1989) to fuel the "engine for increased economic growth." (a) What specific areas of science and technology in which you believe increased U.S. federal funding would permit federal laboratories to cooperate with Eastern Europe? Are changes in technology export controls necessary to permit such activities? (b) If such funding were available, how would you allocate resources and what would be the immediate priorities?

Interaction with federal laboratories would be an outstanding mechanism to initiate cooperation with East European countries. Two areas that appear to deserve immediate attention throughout Eastern Europe are energy technologies and environmental monitoring. Cooperation in both of these areas would be to the best interests of both Eastern Europe and the United States.

The energy choices made by East European nations will have growing environmental and economic ramifications for the United States. Clearly, as the economic gap between developing and industrialized nations narrows, an increasing share of the world's primary energy use will go to meet the needs of these countries. Resulting energy use, including fossil fuels, is likely to contribute significantly to the global build-up of greenhouse and ozone-depleting gases in the atmosphere. Energy use is also likely to contribute to rising pressures on world oil markets.

Energy technology efforts can be an important part of the United States response to these challenges. Energy efficient technologies that are economical will be needed to moderate environmental and oil market pressures. The United States, with the assistance of its federal laboratories, has developed institutional programs for the analysis and study of both energy technologies and environmental impacts of industrial development. Environmental analyses can lead to effective decision making regarding source reduction and environmental restoration from past practices. Energy technology studies can focus on decreasing the energy costs of their products and allow more effective use of their natural resources. The United States will benefit not only through the lowering of worldwide pollution levels. If the United States takes a leadership role in this activity, it is expected that our practices and technology (both services and products) will also become familiar to the East European community and can stimulate further economic development both here and abroad.

As an example of the capabilities of the national laboratories, I would like to relate recent experiences of the Oak Ridge National Laboratory. Since 1982, ORNL has been involved in energy technology and policy assessments in developing countries with the Agency for International Development. This experience has extended to 21 countries in Asia, Africa, Latin America, and the Near East, and it has embraced fossil technologies, energy efficiency improvements, and renewable energy technologies. As a consequence, ORNL represents a unique combination of broad-based international experience and informed perspectives on issues such as technology transfer and public-private sector collaboration.

Scientific exchanges would be key to these interactions. For instance, scientists and engineers from these countries could come to the United States for extended enhancement of their skills in environmental assessment or energy conservation. Then joint teams from the United States and these countries could return to East Europe for evaluation of site specific problems and to develop strategies. A developing pollution control and environmental monitoring industry in East Europe will open significant employment opportunities as well as offer improvements in quality of life. Integration of these technologies into industrial and commercial practice is vital for East European development. These areas are closely related to the original SEED legislation which was involved with fossil energy pollution reduction.

I would not expect that changes in technology export controls would be needed to accommodate these actions because they have low military value.

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June 18, 1990

Mr. John P. Boright
Acting Deputy Assistant Secretary for
Science and Technology Affairs
U.S. Department of State
Washington, DC 20520

Dear Mr. Boright:

Thank you for your excellent testimony before the Subcommittee's hearing on International Science and Technology and Foreign Policy on April 26, 1990.

Enclosed is a copy of your transcribed oral testimony. Please review the transcript for accuracy and return it to the address shown on the instruction slip attached to your remarks. Please be advised that Committee rules require a verbatim transcript and therefore permit only corrections to typographical and transcriptional errors.

Members also have several follow-up questions that are important to the Subcommittee's full understanding of the Title V legislation and surrounding issues. A response within two weeks to the following questions will allow your reply to be entered into the hearing record:

1. How many science counselors do we have abroad? Do we need more?

2. On page 14 of your April 26 testimony, you stated that the Department has been trying to project requirements for science and technology officers abroad, in relation to increased activity related to global climate change. Will these new requirements represent an addition of personnel -- or a shift of existing personnel to new responsibilities? What new skills does the Department intend to develop in the area of global change?

3. There have been funding problems with science and techonology cooperation with Eastern Europe, due to Section 614 of the State Department appropriations bill. What is the current status of our cooperation with Poland, Yugoslavia, and Hungary?

4. Other witnesses have stressed to this Committee the importance of moving into an era in which the U.S. involves internatonal partners in the initial planning and design phases of big projects. This will be necessary to solve global problems and to secure an appropriate level of burden sharing in the future. As the "lead agency" for S&T agreements, is the State Department in a position to facilitate this shift?

5. What progress has been made in getting Japan to bring discussions of its Intelligent Manufacturing Systems (IMS) proposal within the Head of Government U.S. Japan S&T Agreement signed in June of 1988? Which U.S. agency is currently playing the lead role in this issue?

Once again, I am grateful to you for your appearance before the Subcommittee.

Sincerely,

RALPH M. HALL, Chairman
Subcommittee on International
Scientific Cooperation

RMH/ls
Enclosure

Q1. How many science counselors do we have abroad? Do we need more?

A1: We currently have 20 science counselors and 14 other science officers abroad. In several Embassies where we have programs and interests in science and technology cooperation we do need additional staff.

Q2a: You stated that the Department has been trying to project requirements for s&t officers abroad, in relation to increased activity related to global climate change. Will these new requirements represent an addition of personnel or a shift of existing personnel to new responsibilities?

A2a: Both are required to meet the challenge, and we are looking at the options for both.

Q2b: What new skills does the Department intend to develop in the area of global change?

A2b: We are requesting that a three-week course be offered three times per year to train all of our science officers in the full range of science and technology issues, including global change. We have just completed the annual one-week course which included material on global climate change, but we recognize that more is needed. The Foreign Service Institute has requested $250,000 for increased S&T training, including funds to support travel to Washington for science officers posted overseas. Until this request is approved, we will continue with the one-week course. We also continue to support an exchange program with Los Alamos National Laboratory and a short-term visit program for experts to report on S&T abroad. Recently, a NOAA expert visited Japan to report on Japanese climate change programs.

Q3. There have been funding problems with science and technology cooperation with Eastern Europe, due to Section 614 of the State Department appropriations bill. What is the current status of our cooperation with Poland, Yugoslavia and Hungary?

A3. With the rescinding of Section 614 and full FY 1990 funding now available, our S&T cooperation programs with Poland, Yugoslavia and Hungary are back on track. The funding restraint caused some disruption in scientist travel and project planning, particularly with respect to funding the second and third year of multi-year projects. There are a number of meritorious joint projects awaiting funding with Poland and Yugoslavia, and many of these can go forward now that Section 614 has been repealed. Cooperation in Hungary will get under way this summer with the publication of the Program Announcement, utilizing limited reprogrammed funds. Full funding has been requested for the U.S.-Hungary program in the FY 1991 budget.

Q4. Other witnesses have stressed to this Committee the importance of moving into an era in which the U.S. involves international partners in the initial planning and design phases of big projects. This will be necessary to solve global problems and to secure an appropriate level of burden sharing in the future. As the "lead agency" for S&T agreements, is the State Department in a position to facilitate this shift?

A4. The State Department intends to play a facilitation and negotiation leadership role. But a cooperative effort is required if such a shift is to be accomplished. Program agencies must be willing to involve foreign governments in the planning of large-scale science projects at an earlier stage. We will be discussing this within the CISET working groups. Congress and the Executive Branch must be willing to work together to provide sustained, multi-year funding. In the past, other governments have raised doubts about whether sufficient funds will be appropriated to keep major projects on track.

Q5. What progress has been made in getting Japan to bring discussions of its Intelligent Manufacturing Systems proposal within the Head of Government US-Japan Agreement signed in June of 1988? Which U.S. Agency is currently playing the lead role in this issue?

A5. In the recent Joint Working Level Committee meeting (April 30-May 1) under the U.S. - Japan S&T Agreement, the Japanese accepted a U.S. proposal that further U.S. - Japan discussions on the Japanese proposed Intelligent Manufacturing System (IMS) be conducted under the policy framework of the Agreement, as provided for in Article 1. Manufacturing is one of the areas targeted for cooperation under the Agreement.

The Department of Commerce has taken the lead role in organizing and coordinating U.S. industry/academic views regarding the IMS initiative. A series of workshops (July/August) are currently being organized by the Department to further solicit such input with the intention of developing a coordinated U.S. counterproposal that could be negotiated on a multilateral basis with the Japanese and E.C.

On May 14, a tripartite meeting of the E.C., Japan and the U.S. was held in Brussels to discuss the possibility of research cooperation in the intelligent and advanced manufacturing arena. Five U.S. government officials representing the Department of State, Department of Commerce, National Science Foundation, the Office of Science and Technology, and the National Institute for Standards and Technology attended.

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June 18, 1990

Ms. Deborah L. Wince-Smith
Assistant Secretary for Technology Policy
U.S. Department of Commerce
Washington, DC 20230

Dear Ms. Wince-Smith:

Thank you for your excellent testimony before the Subcommittee's hearing on International Science and Technology and Foreign Policy on April 26, 1990.

Enclosed is a copy of your transcribed oral testimony. Please review the transcript for accuracy and return it to the address shown on the instruction slip attached to your remarks. Please be advised that Committee rules require a verbatim transcript and therefore permit only corrections to typographical and transcriptional errors.

Members also have several follow-up questions that are important to the Subcommittee's full understanding of the Title V legislation and surrounding issues. A response within two weeks to the following questions will allow your reply to be entered into the hearing record:

1. Please supply information on the implementation of the Japanese Technical Literature Act. Specifically, how many non-governmental users of the program have there been? Is the program being adequately publicized? At what point will it be possible to perform a cost-benefit analysis of the program?

2. Pursuant to P.L. 100-418 (section 2656 d(a) of Title 22 of the U.S. Code), in its review of proposed U.S. international S&T agreements and activities, has the Commerce Department determined that any proposed agreements were inconsistent with U.S. trade policies, national security policies and relevant executive orders? Which ones? Did subsequent negotiations rectify the problems?

3. Are there instances known to the Department of Commerce when there has been a commercial loss of intellectual property due to practices by the federal laboratories?

4. Are U.S. commercial interests being sufficiently represented throughout the EC 92 discussions? Has there been any interplay between bilateral science and technology activities and the EC discussions? What role does Commerce play in this area?

Once again, I am grateful to you for your appearance before the Subcommittee.

Sincerely,

Ralph M. Hall

RALPH M. HALL, Chairman
Subcommittee on International
Scientific Cooperation

RMH/ls
Enclosure

1. Please supply information on the implementation of the Japanese Technical Literature Act. Specifically, how many non-governmental users of the program have there been? Is the program being adequately publicized? At what point will it be possible to perform a cost-benefit analysis of the program?

In general, we estimate that over 90% of Japanese Technical Literature Program products are distributed to private sector recipients. Our annual Directory of Japanese Technical Resources in the United States is purchased by over 600 organizations each year. The Japanese Technical Literature Bulletin, issued four-to-six times a year, is purchased by nearly 3000 mostly private sector subscribers.

The Program is receiving increased exposure through direct activities and word-of-mouth. We are continually looking for opportunities to advertise it. Our Program Manager recently served on a panel on Japanese information at a Conference Board meeting in New York and has been invited to a repeat performance in San Francisco in the fall.

Any meaningful cost-benefit analysis must define the benefit in terms of the contribution that the information makes to U.S. competitiveness rather than revenue from sale of documents. I do not believe we have the methodology to make such an assessment. I would like to explore this further with my staff and would welcome any suggestions from the Committee.

2. Pursuant to P.L. 100-418 (section 2656d(a) of Title 22 of the United States Code), in its review of proposed U.S. international S&T agreements and activities, has the Commerce Department determined that any proposed agreements were inconsistent with U.S. trade policies, national security policies and relevant executive orders? Which ones? Did subsequent negotiations rectify the problems?

A number of government-to-government umbrella agreements have indeed been found to be inconsistent with these national policies. Negotiations with India, the PRC, Korea and Spain have all stalled over the inability to secure mutual agreement on language regarding the protection and allocation of intellectual property rights. Various agencies have agreed on simplified alternative language which may help to revitalize some of these negotiations.

In addition to these umbrella agreements, we also review many agreements between federal agencies and their foreign counterparts covering specific areas of cooperation. Our goal is to ensure that these agreements are consistent with the spirit of the policies we are pursuing in the broader, government-to-government agreements. In general, we expect agencies to conform to the terms of the broader agreement. However, we do try to work with agencies to adopt appropriate modifications after taking into account the nature of the technology involved, the contribution made by the other side, or other equitable considerations.

There are also a number of other kinds of agreements that we review extensively for their impact on U.S. technological competitiveness and with respect to which we have been instrumental in having clarified or modied. These include co-development agreements (U.S.-Japan FSX), co-production agreements (Korean Fighter Plane), and a proposed agreement between Japan and U.S. industry on Intelligent Manufacturing Systems which Japan was pursuing outside the scope and safeguards of the U.S.-Japan S&T Agreement.

3. Are there instances known to the Department of Commerce when there has been a commercial loss of intellectual property due to practices by the federal laboratories?

There are a number of instances in which important commercial advantages were obtained by foreign sources. The Japanese, for example, were able to achieve substantial advantages in the area of alcohol fermentation which helped their biotechnology industry. The Japanese and other foreign researchers have recognized these facilities for being the national treasures that they are. The real task is to try to encourage our own firms to recognize what cooperation with these facilities can mean in term of their own competitiveness and to encourage them to take advantage of comparable government-supported research opportunities in Japan and elsewhere. Fortunately, we now have in place a series of statutes and programs which give these laboratories incentives to manage and control the technology they develop and to work with U.S. industry to realizing its commercial potential.

4. Are U.S. commercial interests being sufficiently represented throughout the EC 92 discussions? Has there been any interplay between bilateral science and technology activities and the EC discussions? What role does Commerce play in this area?

U.S. commercial interests are well represented in the dialogue that has been developed with the European Community in recent months. We still do not have a "seat at the table" in a formal sense, but the EC Commission is much more receptive to bilateral discussions in a broad range of issues from science and technology to trade and investment.

For example, earlier this month the U.S. Government held two days of bilateral meetings with the EC Commission on testing and certification issues. The Technology Administration was represented on the delegation. Similar bilateral working groups have been initiated in the environmental, biotechnology, food and pharmaceutical, and energy areas. Discussions are also being held with the EC on telecommunications under the auspices of the 1988 Trade Act.

Commerce is a very active player in these activities. For example, Commerce participates in the U.S.-EC High Technology Work Group, a forum that meets twice yearly to discuss technology issues of mutual interest. In addition, a Working Group on EC 92 Science and Technology was formed under the White House Committee on International Science, Engineering and Technology (CISET). The Commerce Department's Technology Administration chairs the Policy Subcommittee of this Working Group. The Committee considers such issues as intellectual property protection, technology transfer, standards development and access to EC research and development.

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

August 2, 1990

Dear Congressman Hall:

Enclosed are responses to the questions that you submitted to Dr. J. Thomas Ratchford on June 18, 1990 following the hearing on International Science and Technology and Foreign Policy which was held on April 26, 1990 before the House Subcommittee on International Scientific Cooperation.

Dr. Ratchford appreciated the opportunity to present to you the Administration's views, and we look forward to continuing discussions on this and other topics with you and your Subcommittee.

Sincerely yours,

D. Allan Bromley
Director

Enclosure

The Honorable Ralph M. Hall
Member
Subcommittee on International
Scientific Cooperation
Committee on Science, Space, and
Technology
U.S. House of Representatives
Washington, D.C. 20515

RESPONSE TO QUESTIONS FROM RALPH HALL

1. QUESTION: You stated on page 4 of your testimony that OSTP, in conjunction with CISET, is currently reviewing the effectiveness of the IPR annex negotiated with Japan.

- **Have there been any instances where intellectual property has been created and allocated under the IPR annex?**
- **Are agencies aware of their responsibilities under the S&T agreement, including the IPR annex?**
- **S&T agreements allow agencies to modify the allocation of rights in the IPR annex. What kind of flexibility should agencies have in implementing agency-to-agency agreements?**

ANSWER: The IPR annex to the U.S.-Japan S&T agreement was negotiated to ensure the proper protection of intellectual property rights and their equitable distribution in the event intellectual property is created in the course of cooperative activities. In that sense, the annex is an insurance policy. No intellectual property has been generated under the agreement since it was signed June 20, 1988.

All agencies are aware of their responsibilities under the S&T agreement, including comparable access, control of sensitive information, and protection and allocation of intellectual property. Most of the agency-to-agency agreements subsequently negotiated incorporate the exact language of the IPR annex of the umbrella agreement. The Department of State, through its Circular 175 process, ensures that all agencies, where appropriate, incorporate the provisions of the umbrella agreement.

As a result of the recent interagency review of intellectual property rights in international S&T agreements, technical agencies do have some flexibility in the use and design of the intellectual property rights annexes to their agreements. To ensure that we continue to protect U.S. interests in these activities, all international S&T agreements now require clearance by technology transfer officers within the technical agencies. These individuals are well equipped to design the most appropriate allocation scheme to suite the particular cooperative activity. Again, the Circular 175 process administered by the Department of State ensures interagency review of the agreements so that all concerned agencies, including the U.S. Trade Representative's office, and the Department of Commerce, have an opportunity to comment on changes to the standard language.

2. QUESTION: The Title V legislation charges the President with improving coordination of all U.S. government international scientific and technological activities and overall foreign policy. In your testimony, you cite many ways in which OSTP is taking a leadership and coordination role in scientific and technological activities.

- **o Would OSTP be better suited to the role presently assigned to the Secretary of State and the State Department pursuant to Title V?**

ANSWER: Title V gives the Department of State responsibility for oversight and coordination of all international science and technology activities. This is a role that we believe the Department of State executes efficiently and effectively. OSTP works very closely with the Department in this function, but limits itself to a policy role, as distinct from operational responsibilities. In addition, OSTP provides policy guidance and promotes the coordination of our international science and technology activities through the rejuvenated Federal Coordinating Council on Science, Engineering, and Technology Committee on International Science, Engineering, and Technology which is chaired by the Department of State.

3. QUESTION: Please discuss how the U.S. government coordinates negotiations on big science initiatives like the SSC, the Space Station, and the Human Genome Project.

- **o Are the goals and objective coordinated between these projects, or are they still handled separately?**

ANSWER: Negotiations on big science projects are currently handled on a case-by-case basis. Because the domestic goals and objectives of these projects are very different, how we address them in international fora frequently has been different from project to project. For example, the SSC and Space Station Freedom are cooperative endeavors for which the end result is a facility which will benefit researchers internationally. The human genome project, on the other hand is a decentralized project with research activities taking place around the world. Subsequently, our approach to international collaboration is somewhat different for each.

On the other hand, our experience negotiating one big science initiative certainly impacts negotiations on another. For example, as a result of our negotiations on the Space Station Freedom with the Europeans, Japanese, and the Canadians, we became aware that these nations want to participate in international cooperative projects as true partners--sharing in the engineering and management responsibilities. Therefore, when we discussed Japanese participation in the SSC with the Government of Japan in May, 1990, we did so in the context of Japan as a true partner. The Japanese recognized this new approach to the SSC and will take it into consideration during their internal deliberations.

In the future, we see an opportunity for developing a general framework for internationalizing big science initiatives. This would allow improved coordination and planning, including equitable funding arrangements and credible agreements that would assure the U.S. being a reliable partner. The Federal Coordinating Council's Committee on International Science, Engineering, and Technology has constituted a new working group to address big science activities and international cooperation.

4. QUESTION: Discuss what OSTP is doing to raise international participation on Global Change and the Human Genome project.

ANSWER: OSTP is actively involved in efforts to increase international consideration of global change, and participates in the planning and preparation of the numerous international conferences on the subject of global change.

OSTP played a major role in the White House Conference on Science and Economics Research Related to Global Change, initiated by President Bush and held in Washington, DC, April 16-18, 1990. Dr. D. Allan Bromley, Assistant to the President for Science and Technology and Director of the Office of Science and Technology Policy, co-chaired the Conference with Dr. Michael J. Boskin, Chairman of the President's Council of Economic Advisers, and Mr. Michael R. Deland, Chairman of the White House Council on Environmental Quality. Seventeen nations and the leadership of the E.C. and the OECD sent ministerial level delegations to the Conference.

The Conference sought to add an integrating focus for international thought on Global Change, by introducing the concept of "Global Stewardship." It also emphasized a new dimension of the international dialogue on Global Change: that economic analysis and research on broad global change policies must be integrated with the science of global change. The need to improve understanding of this dimension has been noted by virtually all world leaders.

The Conference was conceived as an integral part of the on-going international process to understand the science of and policy options for diverse but related global environmental issues such as ozone depletion, greenhouse gases, climate change, food security, water supply, sea level changes, wetlands, deforestation, population change and energy demands. It focuses on scientific and economic research issues as a complement to the ongoing Intergovernmental Panel on Climate Change (IPCC) and to other international forums to address the research agenda for Global Change.

Regarding the human genome project, OSTP, through the activities of both the National Institutes of Health and the Department of Energy, is giving careful attention to international involvement in the support of the human genome. The Human Genome Organization (HUGO) has been established and has received initial funding to implement coordination among countries interested in and capable of cooperative genome research. On a bilateral basis, officials at the national center for human genome research meet with their counterparts from a variety of countries on a

regular basis. They attend international conferences, and welcome proposals for research or bio-ethics related studies from both domestic as well as international experts and institutes.

5. QUESTION: On page 2 of your testimony, you state that the U.S. government needs to involve international partners in the initial planning and design phases of big science projects. Is it fair to say we did not do this with the SSC or the Space Station? On what new projects should we do this early joint planning?

ANSWER: International partners were not involved in the earliest planning for either the SSC or the Space Station. However, for the Space Station, international partners were involved in the definition and design phase. NASA had signed agreements for international partners to do parallel definition and design studies along with U.S. efforts. Regarding the SSC, although no agency of the government formally solicited participation at the beginning by international partners, there were informal contacts at the scientist level. For example, Japanese physicists were involved in work on the conceptual design report for the SSC.

Early joint planning with international partners has been occurring with the International Thermonuclear Experimental Reactor (ITER) as well as with Mission to Planet Earth. The development of both of these new projects has benefited from having international partners involved from the beginning in planning and design. We would expect this process of early involvement to be accelerated, should a successful international framework for support of megaprojects, as noted in the answer to question 3, be developed.

6. QUESTION: What is OSTP's position with the USSR, Japan, Europe, Canada, and others on Moon/Mars exploration?

ANSWER: OSTP supports the position outlined in the President March 30 press release on international cooperation on the Space Exploration Initiative (Moon/Mars exploration). It states:

> "...the United States would seek an exploratory dialogue with Europe, Canada, Japan, the Soviet Union, and other nations on international cooperation in the Space Exploration Initiative."

OSTP is working with the National Space Council on the guidelines which will serve as the basis for the dialogue.

7. QUESTION: With what countries has S&T cooperation lagged because of differences over intellectual property rights (IPR)?

ANSWER: International cooperation in science and technology has slowed down considerably with several countries since the U.S. government began to firmly implement strong intellectual property rights provisions to protect U.S. competitiveness interests. For example, our activities with India have been curtailed by India's lack of adequate protection in several critical areas, including pharmaceuticals and chemicals. A number of agency-to-agency agreements with China have been extended pending renegotiation of the umbrella agreement. Our umbrella S&T agreement with the Republic of Korea was allowed to lapse last year due to disagreements over the IPR annex. Agency-to-agency agreements have lapsed with the Federal Republic of Germany, France, and Italy over issues associated with the European Community as a whole. Umbrella agreements have lapsed with Spain, and, for IPR and other reasons, with Thailand and Turkey. We hope that with the development of a more streamlined annex that addresses many of concerns of these countries, we will be able to reach agreement on several of the agreements in the next several months.

8. QUESTION: On page 4 of your testimony, you state that you are developing streamlined IPR language. When will this new language be agreed upon by U.S. agencies? Will it meet the concerns expressed by European nations?

ANSWER: The revised IPR annex was agreed to by all agencies and issued by Dr. Bromley to the full Federal Coordinating Council for Science, Engineering and Technology, and the Committee on International Science, Engineering, and Technology on May 1, 1990. It has been tabled in the context of ongoing negotiations with several countries including Spain, the European Community, Italy, France, New Zealand and Australia. We believe that the new annex, while continuing to ensure adequate and effective protection and equitable allocation of intellectual property, addresses many of the concerns raised by the Europeans and other countries. The revised annex, however, is a document subject to negotiation, and we anticipate that the Europeans and others will want to propose changes to it. We have not yet received an official response from any country.

NATIONAL SCIENCE FOUNDATION
WASHINGTON D.C. 20550

August 1, 1990

Honorable Ralph M. Hall
Chairman, Subcommittee on International
Scientific Cooperation
Committee on Science, Space, and
Technology
U.S. House of Representatives
Washington, D.C. 20515

Dear Mr. Hall:

As you requested, I have reviewed the transcribed oral testimony before the Subcommittee's Hearing on International Science and Technology and Foreign Policy on April 26, 1990. Minor changes or corrections can be found on pages 79, 80 and 81 of the transcription related to my testimony.

Enclosed are my responses to the additional four follow-up questions raised by Subcommittee members. I hope these responses help to clarify understanding on these issues.

Thank you again for the opportunity to provide the National Science Foundation's views on these important questions.

Sincerely,

Richard R. Ries

Richard R. Ries
Acting Director
Division of International
Programs

Enclosures

Q1: Please elaborate on the process by which the National Science Foundation interacts with the State Department before making programmatic and policy actions in the fields of science, technology and diplomacy.

A1: Interaction with the Department of State

The NSF Act of 1950 mandates NSF to interact with the State Department in matters of international scientific cooperation. More specifically, it provides that NSF may cooperate in international scientific activities only with the approval of the Secretary of State. In practice, NSF has a close working relationship with the Department of State's Bureau of Oceans, Environmental and Scientific Affairs (OES). NSF/OES staff exchanges are common; NSF and OES staff participate in many working groups and interagency committees on matters pertaining to international scientific and engineering cooperation, and at the request of OES, NSF has provided primary staff or executive agent responsibilities for particular international scientific initiatives or agreements. In addition, through the Circular 175 process, NSF consults with the Department of State and other agencies before negotiating formal agreements for international scientific cooperation or programs.

Specific examples of the cooperative NSF-State relationship follow:

NSF is often called upon by the Department of State for informal and formal technical advice on science and related matters. For example, at the request of the Department of State, NSF represents the U.S. technical agencies on a State Department chaired advisory review board for intellectual property rights issues with India.

At the request of State Department, NSF serves as Interagency Coordinator for the U.S.-Brazil Science and Technology Initiative (STI), and as Executive Agent for the U.S.-India STI. NSF also has served as Executive Agent at State's request for a number of intergovernmental agreements for scientific cooperation, e.g., Mexico, Italy, Australia.

NSF participates as an interested U.S. government agency in several State sponsored S&T programs under broad intergovernmental "umbrella" agreements for cultural and scientific cooperation in key regions, e.g., Eastern Europe. In these cases, the S&T programs were formulated primarily to advance U.S. foreign policy objectives. However, NSF and other U.S. technical agencies are called upon to evaluate the scientific projects and progress to ensure that only meritorious and mutually beneficial research is supported by State funds, typically through a "Joint Board" or "Joint Fund" mechanism.

NSF and State work closely together on a number of high-level interagency working groups and committees. For example, the Foundation's Deputy Director serves as Co-Vice Chairman of the new Committee on International Science, Engineering and Technology (CISET) of the Federal Coordinating Council for Science, Engineering and Technology (FCCSET). NSF's Director serves as a member of the Joint High Level Committee under the landmark 1988 U.S.-Japan agreement for scientific cooperation, and NSF's Assistant Director for Scientific, Technological and International Affairs serves as Chairman of the Task Force on Access under that agreement.

While State Department and NSF do not have a formal staff exchange program, NSF and State have frequently shared the expertise and experience of their respective professional staffs. In recent years, NSF employees have served as Science Counselors at U.S. Embassies abroad and a State OES senior official served as NSF Division Director for International Programs. The former Assistant Secretary for OES is currently the Deputy Director of the NSF. On an ad hoc basis, NSF also has accepted State Department employees on TDYs, and currently has several such detailees.

NSF maintains European and Asian regional offices which are located in the U.S. Embassies in Paris and Tokyo respectively. These offices have both reporting and programmatic roles directly related to NSF's research programs and information and analysis functions and are supplemental (complimentary) to DOS responsibility. NSF works closely with the Department of State's Science Offices in each Embassy, sharing information and providing analysis on the scientific trends and capabilities of countries in those two regions.

Q2: Has anything been learned from this experience to help us to negotiate better access to private sector laboratories in Japan?

A2: It is correct to say that the access to Japanese laboratories reported in my testimony was partly a result of the 1988 S&T agreement with Japan. In fact, however, NSF had been obtaining access to Japanese government-operated laboratories for American researchers for years, but at a relatively low annual level. Before negotiations began on the 1988 Agreement, for example, NSF had concluded a Memorandum of Understanding for access to MITI's 5th Generation Computer Project. We had also begun talks with MITI, the Science and Technology Agency, and the Ministry of Education, Science and Culture concerning our desire to increase the number of American researchers in Japanese laboratories for substantive long-term visits. Initiation of negotiations for the S&T Agreement undoubtedly encouraged the Japanese to be as receptive as possible to our requests in order to help deflect criticism on the access issue in the negotiations.

Experience in public laboratory access is not completely transferable to the question of private laboratory access. We do know from our earlier NSF surveys of Japanese private firms that they are interested in having American researchers in their laboratories. Not everyone interested in such an arrangement - on both sides - is necessarily interested in having government support for it. While we can send (and have sent) American researchers to private Japanese laboratories, we have had very few applications for such support. On the other hand, we know that many people have obtained and used the NSF directory of Japanese companies willing to receive American researchers (NSF/Tokyo Report Memorandum). However, the private nature of the transaction between the host Japanese company and the visiting American researcher makes it difficult for us to know the actual numbers of people gaining access to private laboratories in Japan.

Q3: At the conclusion of the hearing, Chairman Hall expressed concern that it is perhaps expecting too much for the scientists of Eastern European countries to immediately adopt NSF's system of competitive grants and peer review. What interim procedure could NSF provide for these scientists as their countries go through the transition to democracy?

A3: The National Science Foundation's experience with merit review and a competitive grant system is of interest to several East European countries as they consider various models for reform of national R&D funding. Representatives of these countries tell us that elements of an open competition, based upon established selection criteria, appeal to their scientific communities.

The NSF does not seek to transfer its system abroad. Rather, we are often asked to explain how our system works and how such a system functions in concert with national priority-setting. In no case have we been told that our approach will be wholly adopted. Instead, each country appears to be fashioning its own unique system for research funding, especially suited to national needs and infrastructure, and borrowing only those aspects of our review and granting methods perceived as useful. We, of course, have been happy to share information in this context.

Frequently our staff receives East European visitors and provides informal orientation programs. At the visitors' request, featured topics often highlight merit review and the proposal process. Similarily when our staff travels abroad for program business or to attend scientific meetings, they prepare for inquiries on these subjects and try to be as helpful as possible when their advice is sought. To give one concrete example: Polish Deputy Prime Minister for Science and Technology, Dr. Jan Janowski recently visited the Foundation. In discussions with our Director, Mr. Erich Bloch, he touched upon a number of points pertaining to scientific cooperation. They concluded with a decision to receive two Polish visitors at NSF this summer who would study methods of merit review and our grant system. NSF agreed to follow-up by sending representatives to Poland in the fall. While the subjects of such discussions often include merit review, our overall objective is the strengthening of long-term ties between the international research communities.

Q4: NSF has signed a Memorandum of Understanding with its counterpart in the Soviet Unfon to coordinate scientific research in several areas.

- o Is there any allocation of intellectual property rights contained in the Memorandum of Understanding?
- o How does NSF monitor rights which may be created as a result of a project sponsored by NSF?
- o Do agencies or scientists promise rights to foreign researchers contrary to the MOU or other applicable agreements?

A4: Yes, the Memorandum of Understanding (MOU) on Cooperation in the Field of Basic Scientific Research between NSF and the Academy of Sciences of the USSR (ASUSSR), signed May 6, 1989, contains specific allocations of intellectual property rights for cooperative research projects conducted under its auspices. The MOU also references and incorporates the general provisions on protection of intellectual property that are contained in the US-USSR intergovernmental Agreement on Cooperation in the Field of Basic Scientific Research, signed January 8, 1989, which is the parent or "umbrella" agreement for the NSF-ASUSSR MOU.

All awards made under this agreement, as with any NSF award, contain the standard U.S. government patent right clause requiring disclosure of inventions. With this important exception, NSF does not monitor other intellectual property rights, such as copyright, arising from work supported under this agreement. We rely on the research community to comply with these and other legal and programmatic provisions pertaining to work carried out under NSF grants. The official public announcement for this program clearly alerts potential grantees that the international agreements governing the program contain provisions concerning allocation of intellectual property rights, and that grantee rights in inventions, writings, and data may be affected.

NSF staff comply with these provisions and do not promise intellectual property rights to Soviet or other foreign researchers that are inconsistent with the provisions of this or other applicable agreements. However, the MOU's provisions allow the U.S. and Soviet investigators to enter into direct arrangements prior to the initiation of the project to alter certain aspects of the "default" allocation of rights prescribed in the MOU.

It is also very important to keep in mind that these formal government-to-government agreements cover only a fraction of the total level of activity in scientific cooperation with the Soviet Union and other countries. This is especially true in basic research, where there is a strong tradition of open communication and frequent interaction. Very often scientific cooperation is informal and, even when federally funded, not incorporated within the provisions of formal bilateral or multilateral agreements. We think this is a fundamentally healthy situation. However, because of the diversity of forms of scientific cooperation it is not possible to say with any certainty that the

intellectual property (or other) provisions of formal international agreements are being observed in all cases. In such cases, if NSF funds are being used, the standard U.S. government patent clause would still govern the allocation of rights to the inventor, but not how the inventor disposes of those rights subsequently.